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THE LATER RESULTS OF OVARIOTOMY, ESPECIALLY IN CASES OF DOUBTFUL CHARACTER OF THE DISEASE[1]

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BEFORE I begin my paper, allow me to express my most sincere thanks to your president, who, by his kind invitation, has given me the opportunity of being present at your meeting. For a long time I have wished to see your country, your hospitals, your scientific institutions and work, and to meet once more my old American friends. But the way is long and America is large, and although time is not always money, yet, ordinarily, it is so fully occupied that it is rather difficult for a professor in a German university to leave his post for so long a time. Certainly it is not desirable to visit America during the autumn holiday months, if one wishes, as I do, to see you at your work. Therefore I was much pleased to receive your invitation which furnished me a pretext to request leave of absence, and I assure you it gives me great pleasure, and I esteem it a great honor to be present at this meeting as your guest.

In considering a suitable subject for discussion on this occasion, the hundredth anniversary of ovariotomy, I thought it might be interesting to discuss the results achieved by ovariotomy in our time, i. e., not the immediate but the later, the final results, particularly in cases where the nature of the disease is doubtful.

Four years ago, at a meeting of the German Gynecological Society at Kiel, I read a paper on a similar subject By further investigations, I have collated the results obtained up to that time and these final results shall be the subject of my paper to-day.

At this time I shall merely touch on ovariotomy as an operation for removing ovarian tumors. The conditions under which the abdominal cavity is opened for this purpose, either by abdominal or vaginal section, being no different from those encountered in other abdominal sections, these technical details will not be treated upon here. Therefore I shall confine my remarks to a discussion of the influence on the subsequent life of the woman, produced by the removal of one or both ovaries which have degenerated into tumors.

As the ovaries belong to those organs which are not necessary to life, the only question to consider is the effect of their removal on the physiological functions, viz., menstruation, pregnancy, etc., and its influence on the whole state of health of the operated woman. As the former functions depend upon the presence of ovarian tissue alone, it is evident that there must be an absolute cessation of these phenomena after the removal of both ovaries. But it is just as evident that they may continue if the least particle of ovarian tissue containing follicles has been left. On the other hand the influence of the complete removal of both ovaries on the general state of health has been satisfactorily settled by a great many scientific

[1] Read before the American Gynecological Society, April, 1909.

investigations, so that there is no doubt on this point. At this time I shall simply endeavor, from the results of my own experience, to answer the following questions:

What are the consequences of the removal of the various kinds of tumors?

Is undisturbed life possible thereafter?

Are the results variable and, if so, what is the cause?

To answer these questions it is necessary to have a strict classification of the various tumors, and this classification may be anatomical or clinical. Taking the latter classification, tumors, as you know, are distinguished as benign, malignant, and those of an uncertain nature. This classification, however, is not satisfactory because by the removal of the degenerated ovary the natural development of the tumor and its influence on the body are interrupted. Consequently a tumor which had no tendency to recur when destroyed, would be called "benign" and only those designated as "malignant" which have a tendency to destroy life by invading the surrounding tissue and by distributing their elements by metastases over other parts of the body. Therefore we must prefer the anatomical, i. e., the histological classification, although we know that this also will not be absolutely accurate. In the present state of our knowledge, however, I believe it best to combine the results of our experience with both, and with this idea in mind I have made the following classification:

1. Tumors of a definite nature (benign or malignant).

2. Tumors of a doubtful nature.

It may be mentioned here that my experience with ovarian tumors is based upon about 600 ovariotomies performed by myself and about the same number of cases which I have witnessed, and in most of which I have assisted during the ten years I was assistant in the clinic of the late Prof. Schroeder of Berlin. All tumors which I removed, especially those of a dubious nature, were thoroughly examined by myself or my assistants, Prof. v. Franque and Dr. Polano.

This classification makes it possible to treat, in a practical manner, the results of ovariotomy with the various kinds of tumors. The first group includes:

1. Retention cysts, follicle cysts, corpus-luteum cysts, cystoma serosum simplex.
2. Fibroid tumors.
3. Dermoid cysts.
4. Adeno-cystoma pseudomucinosum.
5. Carcinoma.

The second group includes:

1. Adeno-papilloma serosum.
2. Pseudomyxoma.
3. Sarcoma (endothelioma, perithelioma, myxoma, etc.).
4. Teratoma.

Retention cysts, not being tumors or growths in the pathological sense, like parovarian cysts, are only of local importance. Therefore their removal or, if necessary, their resection out of the healthy part of the ovary is of no consequence to the whole organism. Bad consequences, either physiological or pathological will not follow the operation. The same may be said of *dermoids* amd *fibroids*. They are local diseases and their removal is of merely local importance.

Adeno-cystoma pseudomucinosum. These tumors, as you know, are the most numerous. Their name has been chosen from the peculiar quality of the fluid they contain. Perhaps they differ also histologically by etiology from the other tumors, but this point is at present not definitely settled. This class of tumors, in my opinion, belongs to the tumors of a definite nature because they lack absolutely the tendency to invade the surrounding tissue, to distribute their elements through the body by metastases, and to recur. The only exception is the so-called pseudomyxomata which will be treated later. It is taken for granted that all parts of the tumor are of the same anatomical structure; however, that may be difficult to determine exactly as it is utterly impossible to examine all parts of the tumor. As oftentimes only small portions of them are of a malignant nature, it is almost impossible to say in the event of malignant recidive later that the primary tumor was really benign. We must necessarily be content with examining the most doubtful parts, particularly the smallest and most polycystic, the hardest, weakest, and most fragile portions, and I think we can be satisfied in most cases, after such a careful examination, taking it for granted that

the whole ovary has been removed. Then we may be sure that the so-called recidive on the pedicle of the primary tumor are nothing but a new development on the remaining portion of the ovary. The designation of these tumors as really benign cannot be altered by the experience of some operators with rare cases where the other ovary is affected in the same manner many years later. It is impossible to say how often it would have been necessary to repeat an ovariotomy for this cause, because in the reports on this subject it is not sufficiently clear whether the later tumor was malignant or benign. Personally, I was only once obliged (out of about 600 ovariotomies) to repeat the operation on the same woman on account of a second benign cystadenoma of the other ovary seven years after the first operation. In another case, Polano was obliged to operate on a woman for a malignant tumor of the other ovary five years after the first operation for a benign pseudomucincystoma.

I am aware that some observations exist in literature on implantation of small parts of such tumors in the abdominal cavity or in the abdominal cicatrix, and that in some of these cases, many years after the first operation, the new tumors have been carcinomatous. But the direct connection between the earlier and later tumors has in most of these cases not been proven, and it is possible there may be some other explanation of the condition. There are extremely rare and exceptional cases where the general pathological importance of these tumors may scarcely be altered. The later results of ovariotomy in these tumors are exceptionally good, and in most cases where but one ovary is diseased the physiological functions in young women are not changed and the general health is not affected.

Carcinoma of the ovary. Carcinoma belongs to the definite and undoubtedly malignant growths of the ovary. Here only the primary carcinoma: scirrhus, adeno-carcinoma and medullary carcinoma will be mentioned. There is no doubt that a great many bilateral ovarian carcinomata are metastatic from other organs of the body, especially the intestines, stomach, etc., and it is clear that in these cases removal of the ovarian tumor will not cure the diseases. In earlier statistics, as well as in our reports, this point is not sufficiently emphasized, and, indeed, it may be very difficult while performing an operation to ascertain definitely whether another organ is diseased or not. The number of these metastatic diseases is considerable. We have seen a large number, and I believe that 5 per cent is not too high an estimate. As the later course of the disease is frequently not carefully observed and sections are not made, it is almost impossible to say what the final results of ovariotomy in cases of primary carcinoma of the ovary are. That they are generally bad is well known. Even the primary results of operation are much worse than in other ovarian tumors. With a general mortality of two or three per cent after ovariotomy in ordinary cases, we lost approximately twenty-three per cent of these malignant cases. Similar results are reported by nearly all operators. More than half of the surviving patients will die in the first year after operation. Therefore, as the number of patients surviving at this time is small, and recidives occasionally come after five or six years, it is impossible to arrive at the percentage of results obtained. In most relative reports the fact is not sufficiently emphasized whether the results are obtained by single or bilateral ovariotomy, and this point is of the utmost importance in order to settle the question whether in all these cases, as a matter of principle, both ovaries should or should not be removed. I have tried to answer this important question out of my own experience. I have performed the operation on forty-three cases of single and sixteen cases of bilateral ovarian carcinoma. In twenty-two of the former the operation was performed by destruction of the diseased ovary alone, no attempt being made to remove the other ovary. The first of the cases operated upon, whom I saw by request some weeks ago, is now living, eighteen years after the operation. One year later she bore a child; she is now forty-five years of age and in perfect health. The extirpation of the hard tumor in this case, which was as large as a man's head, was very difficult and bloody owing to extensive adhesions.

Other patients also were well from ten to twelve years after the operation. Some have borne children once and others several times

since. One lives now nine years after the removal of a most adherent papillary adenocarcinoma with abundant ascites. On the peritoneum was a metastatic nodule, of which I beg to show you microscopical drawings. Several of the women from whom both ovaries were removed, owing to the disease of one, are now healthy, six to nine years after the operation.

These results prove that complete cure in cases of carcinomatous degeneration of one ovary is not only possible, but also that the tendency of the other ovary to the same fatal disease is not so considerable that destruction is necessary. But the prognosis is more unfavorable if the other ovary is also degenerated. Only a few rare cases are known in literature where death has not followed the first year after the operation. Even in those cases, where by microscopical examination only the disease in the other ovary is recognized, the recidive has soon followed. This bad prognosis will perhaps be improved in the future if, as a matter of principle, the uterus is destroyed together with the ovaries. Several times we found subsequent metastases on the mucosa of the uterus, which it was necessary to remove.

The presentation of the facts gives rise to the following conclusions:

1. With the exception of carcinoma, ovariotomy in all the above-mentioned varieties of tumor gives excellent results; the danger of a secondary affection of the other ovary does not exist; the danger of a later spontaneous (idiopathic) affection is very slight. Therefore removal of the one affected ovary will be sufficient. Special precaution should be taken during the operation to avoid the possibility of secondary implantations of the pseudomucincystomata.

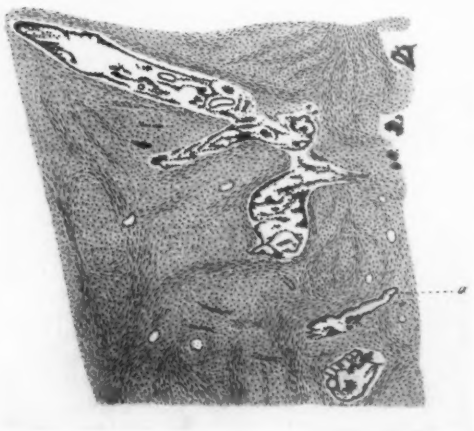

Fig. 1. Peritoneal metastases from carcinoma of the ovary.

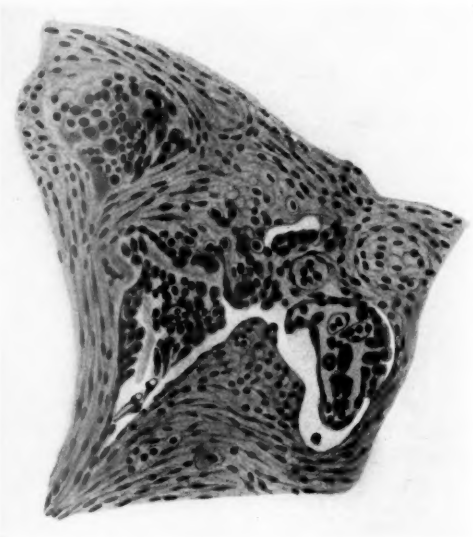

Fig. 2. Same as Fig. 1; greater magnification.

2. If a carcinomatous degeneration of the removed tumor is suspected, removal of the other ovary when it appears to be healthy, is not absolutely necessary in young women. If a microscopical examination indicates that the ovary is affected, relapse will occur in spite of its removal; if it is healthy a cure is possible without disturbing it. In the case of young women, they or their nearest relatives should be consulted and their wishes in the matter considered.

3. Such cases and cases of bilateral affection should be operated on and the uterus removed at the same time.

4. Operation should be attempted in all cases where removal seems to be possible.

5. Resection of a growth from the second ovary is permissible in cases of retention cysts,

fibroids, dermoids; in pseudomucincystomata it should only be done if the patient is ready to risk second operation later; it is absolutely inadvisable in case of carcinoma.

Now we come to the second group, i. e., tumors of doubtful nature.

1. *Cystadenoma serosum papillarœ.* These tumors, as you know, were formerly often considered malignant on account of their frequent bilateral and subserous development, their tendency to implantations on the peritoneum, the development of abundant ascites, etc. Therefore, in earlier statistics they are ranked among malignant tumors. Only by the thorough investigations of Pfannenstiel, Dr. Williams, and other authors, has the real nature of these tumors been recognized and the papillary carcinoma and other papillary tumors distinguished from those which will be mentioned here. In spite of the most suspicious symptoms, they lack the anatomically malignant characteristics, viz., the tendency to invade and destroy the surrounding tissue, the faculty of causing metastases through the blood and lymphatic vessels, the fatal influence on the general health for many years, frequently in spite of repeated evacuation by tapping (300 to 500 times); the implantation growths on the peritoneum, found occasionally during the operation, remain for a long time unchanged and may entirely disappear after the removal of the chief tumor. However, although these anatomically malignant qualities are absent, these tumors are of great importance, owing to the permanent injurious effect on the health, to local symptoms, to the not infrequent relapses after operation, to the implantations on the peritoneum, and the constantly repeated accumulation of fluid in the abdomen. Often these enormous masses of fluid are certainly not ascites, i. e., secretion of the diseased peritoneum, but they are produced by secretion of the tumor cells after the bursting of the very thin walls or of the outside papillæ. Although I think the reappearances of the tumor on the pedicle, many years after the operation, are not recidives in the pathological sense, but only a new development in small remnants of the incompletely removed ovary, and therefore avoidable by thorough operation, the general state of health of these women is threatened much more than after the extirpation of the above-mentioned tumors. The possibilty of further development of the implantations, the undeniable tendency of the other ovary to be affected in the same manner many years after, weaken the prognosis of the operation considerably. It is an open question whether these papillary implantations may become carcinomatous later or not. I have never known of such a result and I think that in those cases the removed primary tumor was carcinomatous, as the carcinomata are often papillary. The diagnosis as to whether it is carcinomatous or non-carcinomatous can be made only by careful microscopical examination, and, where that fails, it is impossible to say whether the primary simple papillary implantation has grown malignant or not.

Summing up, we may say that in spite of abundant peritoneal implantations and bilateral growths cure is possible, but that the general state of health may be seriously impaired, or death may result, in spite of the anatomically benign nature of these tumors, by the return of the disease on the pedicle, causing further development of peritoneal implantations with copious secretion, or by affection of the other ovary. This dubious prognosis will not be improved by trying to destroy the implantations during the first operation. For where that would be possible it would be unnecessary, and where it would be very necessary it would be impossible.

Pseudomyxomata. Some so-called pseudomucincystomata have very thin walls of such extreme weakness that they break very easily and discharge into the peritoneal cavity, the tough, sticky, and mucilaginous masses like a real myxoma. These masses occasionally cause implantation over the whole peritoneum and the intestines, so that it is absolutely impossible to remove them and to clean the peritoneal cavity during the operation. In spite of these fatal complications recovery is undisturbed in most cases, and the final results are unusually good, a fact which can only be explained by shrinking or cessation of further development (just as on the papillary cystomata). But in some cases a tendency to invade the adjacent tissue and organs is evident. Here the later results are doubtful.

the more so, as these tumors have a tendency to attack both ovaries, and to return to the pedicle. Destruction is often difficult on account of their deep and subserous development on the floor of the pelvis. I have had to operate several times on the same case; for example, on a young woman from whom were removed two large pseudomyxomata of both ovaries one and one and a half years ago. Later she developed another tumor deeply seated beside the uterus. At the operation, the whole abdominal cavity was full of the myxomatous masses, which were broken out of the left ligament laterally, and destruction was only possible by removing the whole uterus. She is quite well now, five years after the operation. As in this case repeated operations will often be necessary, but not always with the same fortunate result. Therefore the results in pseudomyxomata, whenever anatomically non-malignant, are much more uncertain than in simple pseudomucincystomata.

Sarcoma. (Myxsarcoma, sarcoma mucocellular, the perithelioma.)

Among tumors of a doubtful nature are included the different varieties of sarcoma, because it is utterly impossible to separate histologically fibroid-sarcoma from sarcomata sensu-strictiori, although the former are no doubt benign while the latter are malignant like carcinoma. Perhaps the malignancy is not so marked on account of their anatomical compactness and the absence of metastases on the peritoneum with the possibility of complete removal, as the pedicle is usually simple and more accessible. The histological classification of the different sorts of sarcoma (endothelioma, perithelioma, etc.,) is so difficult that it is impossible to discuss it here. As a rule, it may be said, that the tumors are more malignant when they consist of round cells without connective tissue than when the connective tissue is considerable. Sarcomatous tumors have occurred, in my experience, in about seven to eight per cent of the cases. However, it is impossible to give the subsequent results in figures owing to the fact that the fibro-sarcomata are never separated in the statistics. Unfortunately, in most of the cases reported, it is not clear whether the diseased ovary alone or both ovaries were removed. Several of my patients from whom I had removed only the diseased ovary, which was in all cases a large sarcomatous tumor, have borne children later and are now quite well, eleven years after the operation. Therefore the tendency of the other ovary to be affected seems to me so inconsiderable that it is inadvisable to remove it in all cases, especially in young women.

Teratoma. The teratoma or solid embryomata belong to the rarest ovarian tumors. They consist of elements of all three germ layers promiscuously mixed and are of the most variable character. It is impossible to enumerate, at this time, the different varieties of these tumors. Opinions concerning their malignant nature differ, and no doubt some of them have been malignant, judging from the malignant sarcomatous degeneration of their connective tissue. In some cases it is cured temporarily at least by extirpation. In a child of six years I have destroyed such a tumor as large as a man's head, leaving the other ovary. She lived and grew quite well until her death, six years later, probably due to tuberculosis. The day I left Wurzburg I heard of the death of a case operated on for struma of the ovary with abundant ascites, two years after the operation.

From these results it is clear that all the tumors of the second group have a common tendency to produce implantations on the peritoneum and the intestines, seriously impairing the health and rendering further operation probable; to return on the pedicle because radical destruction is often rendered very difficult by their anatomical position, and to attack, at the same time, or later, the other ovary. For this reason many practitioners emphasize the necessity of removing, as a matter of principle, the other ovary, even in those cases where it seems healthy macroscopically. I believe, however, that such a decision is very severe on young women and is only justified if such a tendency to spontaneous affection of the second ovary can be absolutely proved. This point has not been sufficiently proved to my satisfaction. As the tendency of ovaries to be affected by metastases from other organs of the peritoneal cavity is great enough, as far as we know, it seems to me possible that later growths in the

other ovary are not spontaneous but metastatic, and they are actually found particularly in weak and soft tumors.

Certainly if the other ovary is affected, although macroscopically healthy, and therefore allowed to remain, the tumor will soon return. But in all cases reported where the second destroyed ovary was proved unhealthy by microscopical examination the tumor returned and the patient died in spite of the destruction of the ovary. For in such cases there are already other infections which will develop later. If the other ovary is not affected removal will be useless, because the tendency to spontaneous development of the same sort of growth is not of great importance, as experience has proved.

It is self-evident that during the operation the other ovary must be thoroughly examined and at the least appearance of infection should be removed together with the uterus itself. Resection of even a very small nodule of growth from the ovary in these tumors is not to be considered. Once I performed it on a young girl, twenty-two years of age, with a round, cellular sarcoma, and five months later the whole peritoneal cavity was filled with tumors.

Therefore the question if the second ovary is always to be destroyed also depends upon the character of the growth. As the papillomata and pseudomyxomata are not malignant growths, the danger of a similar affection of the other ovary is not so serious, presuming that it is recognized and operated upon at the right time. The danger of a second operation is not greater than that of the first and will, in younger women, be repaid by the preservation of the ovary. Following out this principle, we have cured several young women for years, who later married and bore numerous children. In sarcoma no doubt the danger is somewhat greater; therefore the health of these women must be thoroughly and constantly observed. But, as has been stated, even in sarcoma we have several cases where after the removal of only one ovary the patients have remained perfectly healthy for many years. The same may be said of teratoma.

For practice the following theses for tumors of the second group may be maintained:

1. Complete cure is possible with these tumors, especially papilloma and pseudomyxoma, even when bilaterally developed, as well as for unilateral sarcoma and teratoma.

2. If the second ovary on a thorough macroscopical examination seems to be healthy, it may be left, as a removal of both ovaries is detrimental to the general health of young women, and the danger of a spontaneous infection of the second ovary is not very great. However, the condition of the ovary must necessarily be watched for several years.

3. If both ovaries are infected, they, with the uterus, must be completely destroyed.

4. Resection of such a tumor out of the ovary is by no means permissible.

To avoid wandering too far from my theme, there are many questions I cannot discuss at this time, although of the greatest importance to the practitioner; for instance, double ovariotomy, repeated ovariotomy, vaginal or abdominal keliotomy. However, allow me to present you a table containing the special results of our operations.

PERMANENT RESULTS OF MALIGNANT AND DOUBTFUL FORMS OF OVARIAN TUMORS OPERATED UPON UP TO DECEMBER 1, 1906

1. Simple ovarian carcinoma.
Of thirty patients operated upon, seventeen died.
Ten patients died 1 year after operation.
One patient died 2 years after operation.
Two patients died 3 years after operation.
One patient died 4 years after operation.
One patient died 8 years after operation.
One patient died 11 years after operation.

Of the seventeen patients who died, eight died of carcinoma, and one, according to the communication of the physician died from carcinoma of the bowel eleven years after. Two patients in whom the cause of death could not be definitely learned, apparently died of cachexia due to a carcinoma. In this case, at the time of the operation, a progressive carcinoma of the peritoneum was noted.

Without recurrence 7 years, 1 patient.
Without recurrence 8 years, 2 patients.
Without recurrence 9 years, 5 patients.
Without recurrence 11 years, 1 patient.
Without recurrence 19 years, 1 patient.

Concerning three patients, nothing definitely could be ascertained. In one of the patients who has been without recurrence for nine years, the carcinoma had invaded the peritoneum (see microscopical illustration).

2. Carcinoma of the ovary and uterus.
Of ten patients operated upon, nine died.
Seven died in 1 year after operation.
One died in 2 years after operation.
One died in 3 years after operation.

Five patients according to report died of carcinoma. Another patient, in all probability, died in the course of a recurrence. In three patients the cause of death is unknown. According to report, one patient who was operated upon May 20, 1904, for an "adenocarcinoma papillare ov. utriusque" remains well.

3. Simple papillary cystadenoma.

Of the eight patients operated upon, two died. The first patient died in one year after the operation, presumably because of a tumor formation. Another patient died three years after the operation of an inoperable corpus carcinoma; in this clinic a short time previously had received an exploratory incision.

Without recurrence 6 years one patient.
Without recurrence 8 years one patient.
Without recurrence 9 years one patient.
Without recurrence 12 years one patient.
Without recurrence 15 years two patients.
Without recurrence 17 years one patient.

In one patient four weeks after an ovariotomy, the uterus was extirpated by the vaginal route for an adenocarcinoma of the corpus. This patient is now after fifteen years free from recurrence.

4. Papillary ovarian cystadenoma duplex.

Of nine patients operated upon, one died (primärer Todesfall). One patient who was operated upon in 1904 has given us no report, but in all probability is living inasmuch as a letter mailed to her was not returned. She was without recurrence in 1905. The rest of the patients are living.

Without recurrence 8 years 1 patient.
Without recurrence 12 years 1 patient.
Without recurrence 13 years 1 patient.
Without recurrence 14 years 2 patients.
Without recurrence 16 years 1 patient.
Without recurrence 20 years 1 patient.

One patient upon whom a double ovariotomy was performed in the year 1902, experienced an ascites in 1906 and again in 1908, for which she was laparotomized on two occasions and is now perfectly well. One patient operated upon in the year 1893, developed a fairly large hernia at the sac of the scar, which was cured by operation in 1908.

5. Ovarian pseudomyxoma.

Of the four patients operated on, one died in two years after the operation from a pseudomyxoma of the peritoneum. Two patients have not been heard from. The third patient had a right ovariotomy performed in 1901 and left ovariotomy in 1902. In the year 1903 a pseudomyxoma had again developed in the left side. Extirpation of the uterus with ligaments; free from recurrence six years, one patient.

6. Sarcoma, endothelioma, simple ovarian perithelioma.

Of thirteen operated cases, four died. Two patients died in one year after operation, two patients died in two years after operation, respectively, from recurrence.

In three of these fatal cases, a simple ovariotomy was performed and in the fourth, the uterus was extirpated in addition. Nine patients are living and well. Upon six of these cases a unilateral ovariotomy was performed. Two of these patients had the good fortune to become pregnant on several occasions.

Without recurrence 6 years 1 patient.
Without recurrence 7 years 1 patient.
Without recurrence 8 years 1 patient.
Without recurrence 9 years 2 patients.
Without recurrence 11 years 3 patients.
Without recurrence 12 years 1 patient.

7. Sarcoma duplex.

Four patients respectively died one year after operation; three probably from recurrence and one from phthisis.

8. Teratomata.

Two cases. One patient died after six years from a phthisis, and the other who was operated upon in 1903 and still well in 1905, has not been located.

THE ROLE OF HEART MASSAGE IN SURGERY[1]

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WHILE the truth of the dictum "*Nulla pulsa, nulla therapia*" remains unassailed, it cannot be so aptly applied to the surgery of the present day. Not only without pulse, but without the contractions of the heart or the expansions of the lungs, has life been made possible, largely through heart massage.

The expression, heart massage, *herzmassage*, or *massage de coeur* in its surgical meaning, implies the manual stroking, rubbing, or kneading of the organ either by (*a*), costal resection, (*b*), through an incision in the diaphragm, or (*c*), with the diaphragm interposed between the hand and the heart. The same term is in general use by specialists in diseases of the heart, who refer to it as a system of gradual exercise to increase the tone of the heart muscle,

[1] President's address before the George Washington University Medical Society, May 15, 1900.

but such a denomination is deplored and considered unfortunate (1).

Isolated cases of heart massage have been reported since 1880, a total of forty-eight, and laboratory experiments have been both numerous and thorough in the past eight years, yet it is an astonishing fact that the clinical results and laboratory deductions have remained separate and distinct entities, possibly because the surgeon has not had laboratory training and physiologists lacked surgical opportunities. It is my purpose to consider these facts by elimination and segregation and hope to prove that the net result is a permanent advance in surgical methods. It is common knowledge that we cannot duplicate in the rabbit, cat, or dog, clinical conditions in man, but we also know that animal experimentation is largely responsible for our present conception of digestion, of cerebral localization, of immunizing sera, etc., and while a due allowance is made for certain inherent and fundamental differences, in the aggregate the results are entitled to serious consideration.

In the many conditions of cardiac failure or inhibition, the most favorable one for the practical use of cardiac massage has been in chloroform syncope, as the environments approach the ideal for its use. Frequently the abdomen is open, assistants are numerous, and instruments are at hand. It is a condition also, unfortunately, that is not rare, one that costs many lives annually, and a condition under which most of the successful, as well as the unsuccessful cases of heart massage was employed. In other comatose states, heart massage may be equally indicated, yet in my opinion its bounds must be recognized, as its abuse will bring it into disrepute. It is with the heart failure which is associated with chloroform narcosis that I deal more particularly.

Why does the heart stop in chloroform anæsthesia? It is equally pertinent to ask; why does the heart beat? One would infer from the enormous amount of literature upon the cause of the rhythmic contractions of the heart that the question is an unsettled one, and such is just the case. By many it is claimed that the ganglion cells in the heart muscle discharge impulses periodically, the so-called neurogenic theory, but this is answered by others with the demonstration of contraction of the isolated apex, which is devoid of nerve tissue. The prevailing opinion leans toward the myogenic theory, or spontaneous contraction of the heart muscle, initiated by the calcium, potassium, and sodium salts of the blood. A very plausible explanation has been advanced by A. K. and Mary Sallom (2), and their laboratory findings sustain their contentions. The Salloms believe that an enzyme in the heart is activated by the action of calcium salts and this ferment in turn inaugurates the contraction of the heart muscle.

From a surgical standpoint, the failure of the heart in the majority of instances is embraced by three conditions, namely: following respiratory failure, reflex inhibition, and primary fall of blood pressure. The action of chloroform upon the mammalian heart leaves little room to doubt its depressing effect directly upon this organ, in addition to its earlier effect upon the respiration. Sherrington (3), studied the effect of chloroform upon the heart muscle by allowing Ringers fluid, to which was added chloroform in the strength of 15 parts in 10,000, to flow through the coronary arteries, and in thirty minutes abolished auricular and ventricular contractions. He amplified the experiments and concluded that the heart muscle rapidly takes up chloroform and that the speed and completeness of the recovery is remarkable when the chloroform containing fluid is replaced by fluid free from chloroform. Syncope of the heart, let us remember, is rarely primary in anæsthesia, though this may be at variance with the common belief. This has been my clinical and laboratory experience. In every animal, about twenty, respiratory paralysis preceded cardiac failure by a minute or more. Dr. Thos. F. Lowe (personal communication), in over 2,700 anæsthetics, states that in the only death during this series, chloroform was being administered, but the heart was functionating at least half a minute after breathing had ceased. Mary Magaw (4) refering to chloroform, in an article entitled "Review of over 14,000 Surgical Anæsthesias" quotes Finney as follows: "It is well to watch the character and rate of the pulse, but of far more importance to watch the respiration as the earliest indication of danger." The Hyder-

abad Commission maintained in a most carefully prepared report that primary heart failure did *not* occur. Buxton (5) says that Leonard Hill explains primary cardiac exhaustion in this way: "The concentrated chloroform causes struggling and closure of the glottis, raising the intrathoracic pressure, which pressure diminishes the output from the right auricle and ventricle, congesting the venous system and lowering the arterial tension. The blood supply to the coronary arteries is diminished from fall of arterial blood pressure, the oxygen in the blood is diminished, and therefore nutrition of the heart is impaired. Finally from excitation of the respiratory center, the animal is forced to take two or three deep inspirations. The lungs are at once surcharged with chloroform, the blood reaches the coronary arteries carrying a dose of chloroform sufficient to throw the heart into paralytic dilatation."

In extremely rare cases cessation of the heart may be primary, and in those cases an idiosyncrasy may explain it.

Reflex stimulation has a marked effect upon the heart, so have emotional impulses, but it is very doubtful if total inhibition can be produced in this manner. Rise and fall of the blood pressure is largely reflex, but what relation is the heart contraction to the blood pressure? Peripheral resistance is as important in maintaining pressure as contraction of the ventricle. Fall of blood pressure and secondary enfeeblement of the heart is quite possible, and I accept the view of Porter (6) who says that in the human subject we cannot determine with certainty whether the alteration in the heart beat is primary or secondary to abnormally low pressure. Ransohoff (7) conducted experiments to ascertain the relation of stimulation of gastric and splanchnic branches of the pneumogastric nerve in their relation to blood pressure. Manipulation of the abdominal viscera showed slight alteration with immediate return to normal. A finger or hook in the foramen of Winslow caused a marked drop in blood pressure in the rabbit, confirmed in man, with this addition, that pressure upon the portal vein is just as potent in lowering the arterial pressure. These facts are well worth remembering.

Summed up briefly, we may say that the heart stops from respiratory failure, entailing insufficient oxygen, low blood pressure, and the action of chloroform directly upon the heart muscle.

If asked to define resuscitation, we would most probably state that it is restoring life when life has seemingly been extinct. There is not a fast line between the living and the dead; one state merges into the other with such delicate shading than no human agency can separate the two. Pike, Guthrie, and Stewart (8) express it well: "If we knew the difference between an organ whose power of normal function is in abeyance but which is capable of resuscitation, and the same organ absolutely alike, as it seems to all our ordinary tests, when it had just passed beyond the limit of possible resuscitation, we should not be far from an exact knowledge of the meaning of life." In a paper before this society in February, Dr. A. F. A. King (9) dissipated the thought that transition from the animate to the inanimate is instantaneous. It would seem entirely correct to speak of the somatic and molecular resuscitation, the former pertaining to the visible resuscitation, the latter relating to the renewed cellular activity, invisible but equally as essential to life.

During a period of inhibition of the heart and respiratory centers, the various organs of the body are deprived of the circulation of a vital fluid. Under favorable circumstances, restoration of the blood pressure and ventilation in the lungs, the function of the cells in the many organs and tissues will be regained. The mere contraction of the diaphragm and heart muscle may not restore the glycogenic function of the liver, the secretion of the pancreas, the selective action of the cells of the kidney, or the phagocytosis of the leucocyte, without which, resuscitation is incomplete. It is just as necessary to life to revive the damaged cells of the liver as cells of the encephalic cortex. Brown-Sequard demonstrated that muscles could be resuscitated twenty-four hours after so-called death. We must conceive resuscitation as embracing not only the restoration of the grossly active organs, but also restoration of the functions of organs and structures in which the greatest changes are chemical and microscopical. It has been shown repeatedly

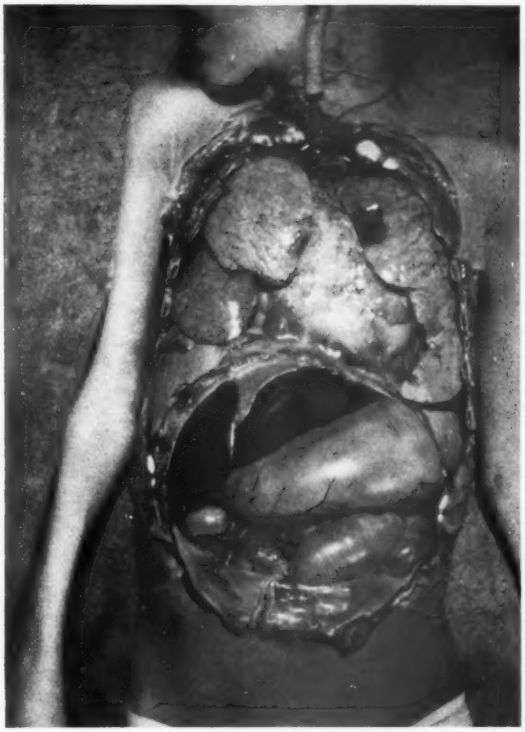


Fig. 1. Showing relation of heart and lungs (inflated).

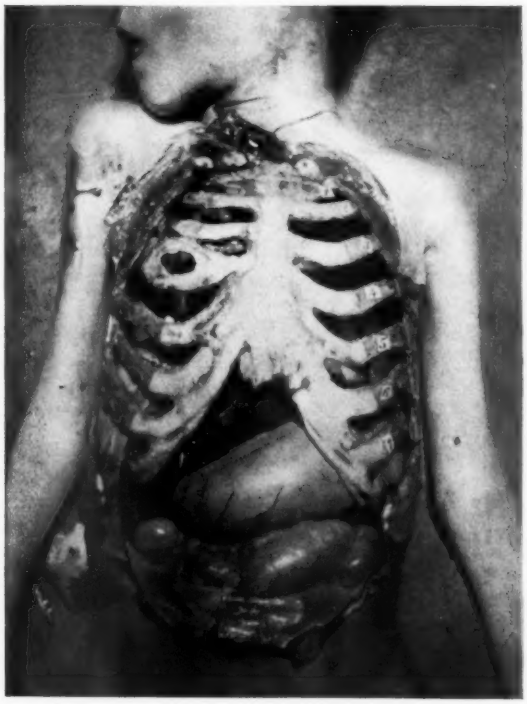


Fig. 2. Showing relation of heart and ribs.

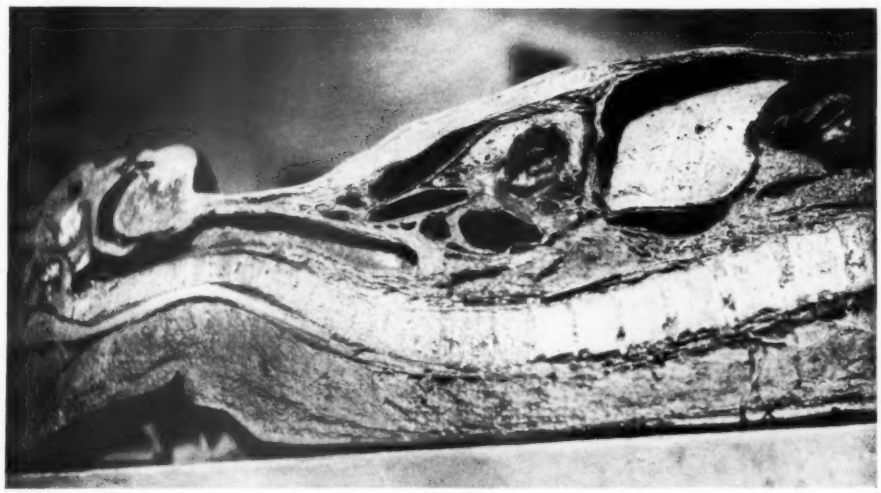


Fig. 3. Showing relation of heart and diaphragm. Longitudinal section, frozen subject.

that all cells of the body are not resuscitated with equal ease, the cerebrum being especially difficult.

The physiological research in the field of heart massage as a means of resuscitation has borne fruit. It is greatly by the laboratory methods that we have been able to arrive at definite conclusions, to assort facts as it were, and to compile them into laws. There are at this time problems associated with resuscitation that remain unfathomed, but the darker fields will be illuminated chiefly by the efforts of the men who work in silence, without the encomiums of their conferees or the plaudits of the public.

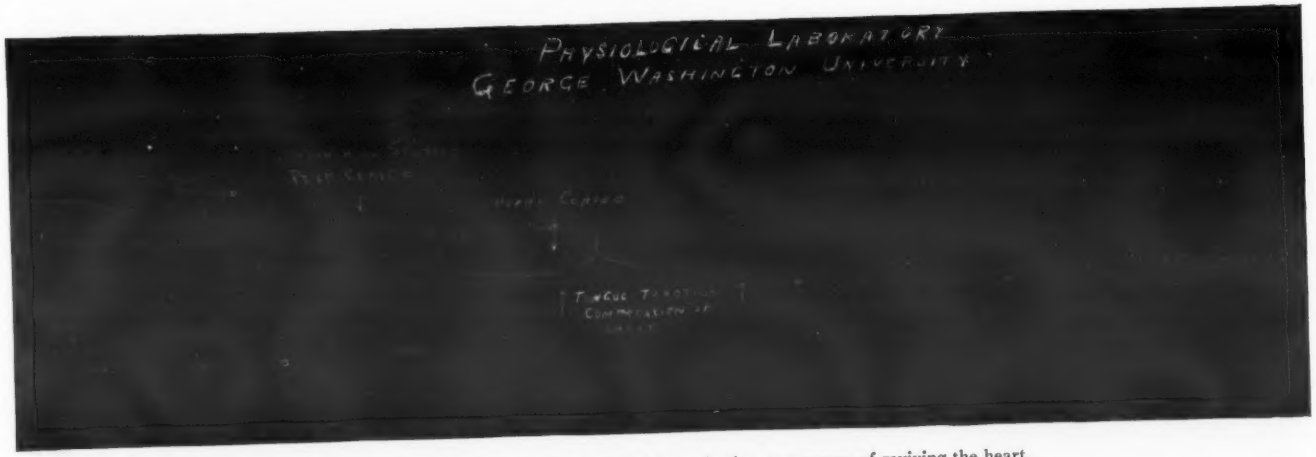
In a discussion of resuscitation before the *Congres Francais de Chirurgie* in 1902, Gallet declared that massage was incapable of producing an artificial circulation. Vidal admitted that vigorous massage would stimulate the heart beat, but it was incapable of recruiting the function of the cardiac pump. d'Halluin (10) (11) demonstrated beyond the shadow of a doubt in animal work, that massage of the heart raised blood pressure and caused circulation of the blood. He says: "In registering the pressure in the femoral by means of the kymograph, we have established a rise of 7 to 8 centimeters of mercury, and upon cessation of the massage, the pressure returned to zero, only to rise each time the heart was compressed." In about 100 cases of chloroform anæsthesia in dogs, he reports fifty-five successful cases of resuscitation by massage of the heart.

Crile and Dolley (12) state their work upon resuscitation by direct and indirect cardiac massage would warrant this summary: "By cardiac massage alone animals were rarely resuscitated at any time after the quiescence of the circulation and respiration. By combining either direct or indirect cardiac massage with artificial respiration and the head down position, a certain percentage of the animals ecovered after the lapse of from one to three minutes. The results are quite uncertain, and in the case of death from chloroform, recovery was the exception."

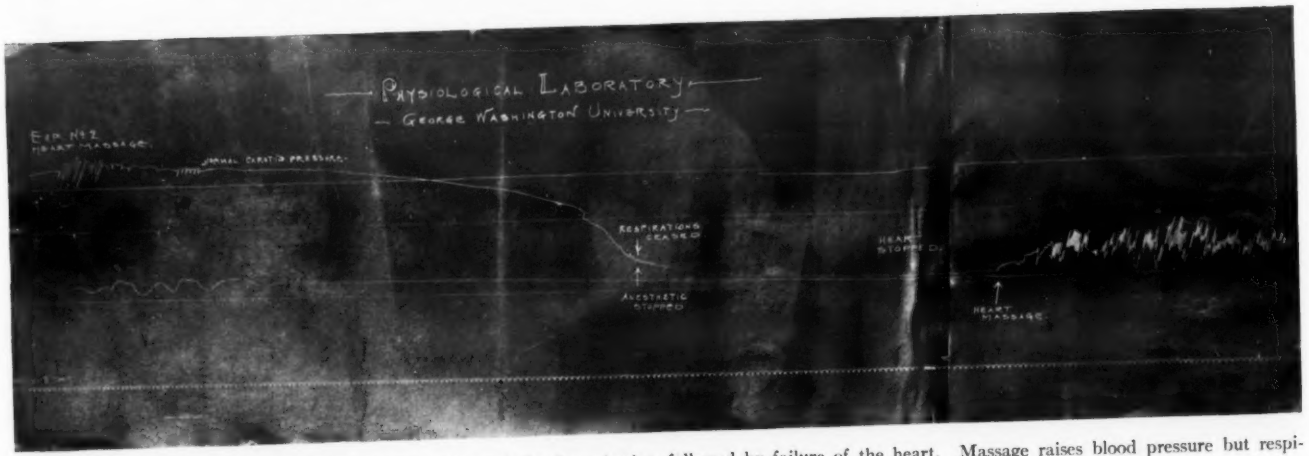
My experiments upon about twenty animals (rabbits and cats) have been productive of the unexpected in some instances and confirmed previous theories in others. Briefly stated, the method was as follows: the animal was anæsthetized with chloroform and in some a tracheotomy tube used and the vapor given through a bellows, a cannula inserted in the carotid or femoral artery, connected with a Hurthle manometer and the pressure registered upon a slowly moving kymograph. When respiration was suspended, auscultation failed to detect the heart sounds, but an opening was made in the epigastric abdominal wall through which the contracting heart could usually be felt pulsating. Not until the heart ceased contracting, indicated by the finger, was massage employed. The pulse felt in the carotid or femoral ceases always before the heart actually stops; an interval of a minute or more may elapse before the heart is quiet.

The relation of the respiration to the heart action is interesting. In every instance, in the animal work of my own, the respiration failed before the heart. This was likewise true of my clinical cases. The fact that the heart beat could not be heard through a stethoscope is not an indication that this organ is at rest, as the cardiac muscle invariably continued its rhythmic contraction several minutes after all sounds ceased and with little or no blood pressure indicated by the manometer. We were not successful in restoring either respiration or circulation by artificial respiration alone, even by inflating the lungs with a bellows, after the heart had ceased. We were not aware at the time of the work of Pike, Guthrie, and Stewart in this field, but agree in every particular when they say that "resuscitation of the heart after it has ceased to respond to a manometer, may sometimes be accomplished by extrathoracic massage and artificial respiration, but only during a period that the heart continues to beat. Direct massage of the heart is the most certain method at hand for resuscitation, and proper blood pressure is necessary for its continued activity. Anæthetics, hæmorrhage, and induced currents applied to the heart make resuscitation more difficult than asphyxia alone."

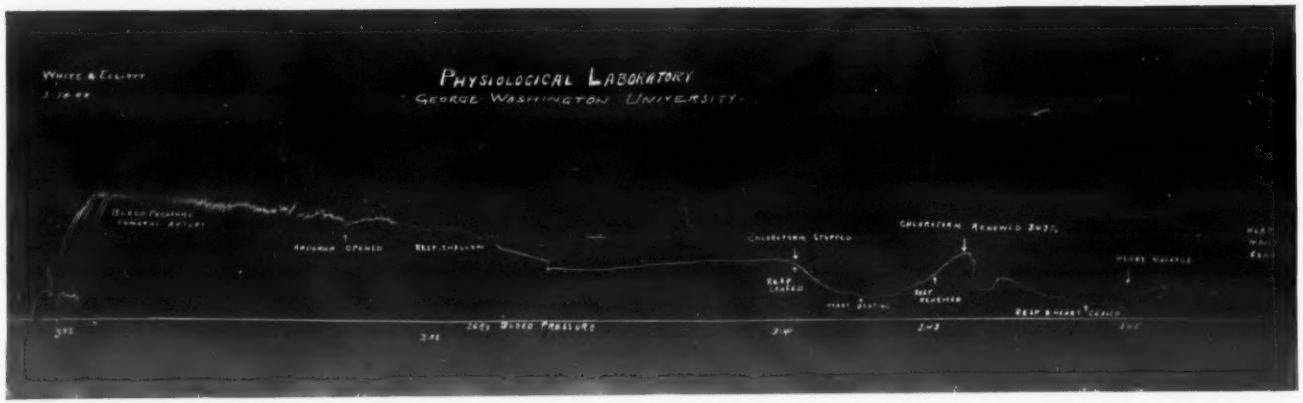
Artificial respiration, by compression of the chest, tongue traction, or inflation of the lungs, will not raise and *maintain* blood pressure. In kymogram 1, this is shown.



Kymogram 1. Showing failure of artificial respiration as a means of reviving the heart.



Kymogram 2. Showing fall of blood pressure and paralysis of respiration, followed by failure of the heart. Massage raises blood pressure but respiration is not renewed.



Kymogram 3. Showing that the heart continues after cessation of respiration. In this instance respiration was resumed without artificial aid.

Kymogram 4. Showing resuscitation of the animal by heart massage and tongue traction after respiration and circulation were paralyzed.

In kymogram 2, will be noted the blood pressure under full anæsthesia. As the chloroform is pushed, the pressure falls, but individual contractions of the heart are not recorded on the slowly moving kymograph, because the action of the heart is quite rapid and very feeble. The respiration ceases first, then the heart. Without any effort to stimulate the respiration, the heart was massaged, showing a definite rise of blood pressure during such manipulation, and against the operator's fingers could be felt the delicate contractions of the ventricles. This seems proof that the subdiaphragmatic massage will raise and maintain pressure for a brief period, one requisite at least that is fulfilled in order to resurrect the heart.

In kymogram 3, it may be seen that the respiration ceased while the blood pressure was well above zero, the chloroform was withdrawn, but the effects were still manifested by a further fall in pressure, yet the heart continued to beat (by the palpation test, not by auscultation), and without massage or artificial respiration the diaphragm resumed its activity. A very small amount of chloroform at this stage caused a rapid fall with inhibition of both respiration and circulation in the order named. Massage alone, as in the previous case, restored pressure for a brief period, but it is to be borne in mind that no effort was made to assist respiration.

Kymogram 4 illustrates the salient features of the previous ones with this exception: heart massage and tongue traction restored both respiration and blood pressure. The animal was rapidly reacting and was dispatched with more chloroform.

I would characterize these experiments as establishing:

1. Respiration ceases before the heart ceases its action.

2. Artificial respiration alone is rarely successful when both heart and respiration have failed.

3. It is possible to resuscitate by heart massage and artificial respiration.

Fibrillary contractions of the heart and voluntary muscles were noted in many of the cases terminating fatally.

In several of the cases the heart was examined port-mortem, and the only macroscopical changes seen were dilatation of the ventricles with venous blood in the fluid state.

The surgical methods of approaching the heart for this method have been three, with little modification.

The direct method consists in resection of the third, fourth, and fifth, or the fourth and fifth ribs, two or three inches from the sternum turning back a flap with a sternal attachment. The pericardium is then opened and the hand inserted.

In the transdiaphragmatic method, a vertical incision is made just below the ensiform cartilage and a second incision through the diaphragm and pericardium. This prevents pneumothorax.

The subdiaphragmatic method departs from the latter one in that only the abdominal incision is made, and with the hand immediately beneath the flaccid diaphragm, the heart may be massaged.

The total number of cases reported up to this time is forty-eight and including two additional cases of my own, brings the total up to fifty. Among this number I have not included those of Crile or the one of Cheever, in which compression of the chest over the heart was the only form of heart massage, hardly, as I take it, within the meaning of the term.

My cases are as follows:

CASE 1. C. M. Male, 13 years. Admitted to hospital January 1, 1908, for a wound of the abdomen, caused by the premature discharge of a shotgun. Between the left iliac crest and the last rib, was an area about four inches in diameter, from which the muscle and skin were shot away, the intestines protruding, punctured, and torn in dozens of places for a distance of twelve inches. Chloroform was given, the wound cleansed, shot, clothing, and wadding removed, and 13½ inches of intestine resected and anastomosed by the Connell method. Several punctures or bird shot wounds in other parts of the intestine were closed. During the intestinal work, the breathing became shallow, then ceased, pupils dilated, and the pulse became impalpable. He was promptly placed in the Trendelenburg position and the usual hypodermic medication resorted to. After two minutes, neither respiration nor pulse had been re-established, and the pupils remained unaltered. At this juncture, massage of the heart was begun by compressing the organ with the right hand under the diaphragm and counter-pressure made with the left over the sternum, at the rate of about thirty or forty per minute. The heart could be distinctly felt through the diaphragm, but did

not immediately respond to the massage. After about one minute, during which time artificial respiration and heart massage were kept up, feeble contractions could be felt in the heart, followed by more definite and individual ones. The pulse could be felt in the temporals shortly after. The pulse became quite full, the pupils contracted, and the operation was completed under ether. He reacted well and seemed on the road to recovery, but on the eighth day, trismus developed and he died eleven days after the operation from tetanus. A partial necropsy showed perfect union of the gut and a healthy condition of the entire intestine.

CASE 2. P. P. Female, 25 years. Admitted to hospital with doubtful history of miscarriage. Examination of heart before the operation was made and no organic lesion was found. The thyroid gland was slightly enlarged. Chloroform was administered, and the patient took it well. The uterus was curetted and it was my intention to explore the abdomen, and as the patient was being changed from the lithotomy to the dorsal position, the respiration faltered, the pulse became weaker, with slight cyanosis. The head was lowered, jaw elevated, and the condition improved promptly. As soon as the horizontal position was assumed, the cyanosis returned, respiration ceased completely, and the pulse failed rapidly, all without additional chloroform. Artificial respiration in the Trendelenburg posture was instituted at once, and hypodermics of strychnia given. After five minutes, no visible change was noted. An incision was made in the median line and the heart massaged by the subdiaphragmatic method. The pulse could be felt slightly during massage, but never in its absence. There were no independent contractions of the heart muscle. After twenty minutes' work, the hopelessness of resuscitation was only too apparent, and all efforts were abandoned. An autopsy was not allowed, but the pelvis was explored, revealing an abscess.

CASE 3. (Previously reported) (14) J. D. Male, 12 years, diagnosis, popliteal abscess following infection of the foot, one month duration. The heart sounds were normal. Chloroform had been administered fifteen minutes when the patient was brought to the operating room. The knee was carefully cleansed, consuming ten minutes in this detail. As the operation was about to proceed, it was noticed that the child was not breathing. The anæsthetic was stopped and *not* resumed later. The pupils were widely dilated, the color of conjunctiva pale, not cyanotic. Pressure was made on the chest five or six times, but respiratory movements were not visible. The pulse could not be felt by the anæsthetist. The patient was immediately placed in the Trendelenburg position, the tongue and jaw drawn forward, and artificial respiration practiced by the Laborde and the Sylvester methods. Strychnine, gr. 1-40, was given hypodermically. The efforts to revive the boy were kept up more than five minutes, actual time, though it seemed much longer and at no stage could I or any other person feel the pulse. Cocaine, 25 minims of a 2 per cent solution, was also given hypodermically.

At this stage, life seemed extinct and more heroic measures were thought justifiable. Accordingly, the abdomen was opened from the ensiform cartilage to the umbilicus, and the hand inserted above the stomach and under the diaphragm. The heart could be easily felt through the flaccid partition. With the left and on the thorax, over the heart, the fingers of the right hand compressed the heart about twenty-five times per minute. The sensation to the hand was similar to that imparted by a movable kidney.

After about one minute a feeble tremor could be felt. Strychnine, gr. 1-40, was given hypodermically at this time. The massage was continued and very soon yhthmical pulsation could be felt against the fingers, and assistants then detected a feeble pulse at the radials. After seven minutes the apex beat was distinct and at the rate of 120 per minute. The abdominal wound was closed, the abscess opened and drained, and leg placed in plaster. The operation was completed at 1 P. M.

At 2 P. M. the patient had a convulsion, lasting not over a minute, tonic in nature. This was repeated at 3, and at 5 he vomited and at the same time had a mild spasm. The convulsions were very much of the strychnia type, any little irritation causing rigidity. Bromides, chloral, and small doses of morphia were used. The pulse gradually became accelerated, the temperature rose to 105° before death, and the spasticity was replaced by profound relaxation. He died at 9 A. M. on the day following the operation, or twenty hours after resuscitation. In some respects the symptoms simulated acetonemia or acidosis, but both acetone and diacetic acid were absent from the urine.

The reported cases can be the only basis for a comparative study, though it is not improbable that many unreported cases would alter the relative proportion in the successful, partially successful, and unsuccessful cases. We are cognizant of the fact that failures are less likely to receive the publicity of brilliant achievements, a bit of human nature not confined to the medical profession.

Of the fifty cases reported, twenty per cent or ten were saved, if I may include my case which died on the eleventh day, of an affection in no way connected with massage of the heart. Eight of the ten patients were saved by subdiaphragmatic massage, two by direct, and none by the transdiaphragmatic. Fourteen patients were partially revived, living from thirty minutes to twenty hours, death in several instances being due to a toxæmia of an unknown etiology. It appears that the subdiaphragmatic method has surpassed the earlier methods in percentage of recoveries.

A consideration of the methods may explain the discrepancy. The direct method consi-

REPORTED CASES

No.	Operator	Date	Anæsthetic	Method	Result
1.	Niehaus (15)	1880	Chloroform	Direct	Died immediately
2.	Bazy (16)	1892	Chloroform	Direct	Died immediately
3.	Michaux (17)	1898	Chloroform	Direct	Died immediately
4.	Tuffier et Hallion (18)	1898	Not stated	Direct	Died in few minutes
5.	Mauclaire (19)	1899	Chloroform	Direct	Died immediately
6.	Prus (20)	1900	Asphyxia, hanging	Direct	Died immediately
7.	Maag (21)	1900	Chloroform	Direct	Died in 3½ hours
8.	Depage (22)	1901	Chloroform	Direct	Died in 30 minutes
9.	Igelsrud (23)	1901	Not stated	Direct	Recovery
10.	Poirer (24)	1901	Chloroform	Direct	Died immediately
11.	Mauclaire (25)	1902	Chloroform	Direct(?)	Died immediately
12.	Gallet (26)	1902	Chloroform	Direct	Died immediately
13.	Gallet (26)	1902	Chloroform	Direct	Died immediately
14.	Starling and Lane (27)	1902	Gas and Ether	Subdiaphragm	Recovery
15.	Sick (28)	1902	Chloroform	Direct	Died in 24 hours
16.	Gray (29)	1902	Not stated	Subdiaphragm	Recovery
17.	Keen (23)	1903	Chloroform	Subdiaphragm	Died immediately
18.	Mauclaire (31)	1903	Chloroform	Transdiaphr.	Died immediately
19.	Keetley (32)	1903	Chloroform	Subdiaphragm	Died immediately
20.	Cohen (33)	1903	Chloroform	Subdiaphragm	Recovery
21.	Drucbert&d'Halluin(34)	1903	Chloroform	Direct	Died immediately
22.	Le Fort (35)	1903	Asphyxia	Direct	Died quickly
23.	Trzebicky (42)	1903	A. C. E. Mx.	Direct	Died immediately
24.	Djemil Pacha (36)	1904	Chloroform	Direct	Died (time omitted)
25.	Jeanbreau (42)	1905	Chloroform	Direct	Died in 16 hours
26.	Gray (29)	1905	Asphyxia	Subdiaphragm	Died in 3 hours
27.	Munteanu (42)	1905	Chloroform	Direct	Died immediately
28.	Sencert (37)	1905	Chloroform	Subdiaphragm	Recovery
29.	Munteanu (42)	1905	Chloroform	Direct	Died immediately
30.	Depage (38)	1905	Chloroform	Subdiaphragm	Died in 16 hours
31.	Munteanu (42)	1905	Chloroform	Direct	Died immediately
32.	LeNorment (39)	1905	Chloroform	Direct	Died in 5 hours
33.	Mauclaire and Coqueret (42)	1905	None	Transdiaphr.	Died immediately
34.	Vanvert (42)	1905	None	Subdiaphragm	Died immediately
35.	Conkling (40)	1905	Ether	Direct	Recovery
36.	Alves (42)	1905	Not stated	Direct	Died in 1 hour
37.	Smith and Daglish (41)	1905	Chloroform	Subdiaphragm	Recovery
38.	Keetley (32)	?	Not stated	Subdiaphragm	Died immediately
39.	Gross and Sencert (42)	1905	Chloroform	Direct	Died immediately
40.	Subbotic (42)	1905	Chloroform	Subdiaphragm	Died in 21 hours
41.	Green (32)	1906	Chloroform	Subdiaphragm	Died in 20 hours
42.	Gross and Sencert (42)	1906	Chloroform	Subdiaphragm	Recovery
43.	Gross and Sencert (42)	1906	Chloroform	Subdiaphragm	Died immediately
44.	Green (32)	1906	Asphyxia, diphtheria	Transdiaphr.	Died in 1½ hours
45.	Ramsey (32)	1906	Chloroform and Ether	Subdiaphragm	Recovery
46.	Wikerhauser (42)	1907	Chloroform	Direct	Died in 2½ hours
47.	White (14)	1908	Chloroform	Subdiaphragm	Lived 11 days, died of tetanus
48.	Sievers (42)	1908	Chloroform	Direct	Died in 15 hours
49.	White	1908	Chloroform	Subdiaphragm	Died immediately
50.	White	1908	Chloroform	Subdiaphragm	Died in 20 hours

SUMMARY

Method	Successful	Partially Successful	Failures	Total
Direct	2	8	18	28
Transdiaphragmatic	0	1	2	3
Subdiaphragmatic	8	5	6	19
Total	10	14	26	50

in making two incisions, one from the junction of the left third rib and sternum outward about three inches, and a second incision, parallel to the first, begins at the fifth rib and sternum. A vertical incision connects the previous ones close to the costosternal articulation. The 3, 4, and 5 costal cartilages are resected, ½ inch from the sternum and the entire flap turned outward. The pericardium is opened, the hand is inserted, and perfect massage or rhythmical compression of the heart practiced. In this method, the pleura is generally opened, entailing pneumothorax. Wehr has modified this method by making the hinge of the flap at the right sternocostal margin, with the idea of avoiding the pleura. Boreau (43) states that pneumothorax is the serious obstacle to the successful performance of this operation. A reference to the accompanying dissections will show the difficulty that besets one in an effort to expose the heart without penetration of the pleura, and if we add the necessary haste of such an operation, preservation of this delicate investment offers almost insurmountable difficulties.

The transdiaphragmatic method, theoretically at least, possesses some advantages over the previously described technique, mainly in the possibility of invading the pericardium without pneumothorax. An incision through the abdominal parietes is made from the ensiform to the umbilicus, or sufficiently large to admit the hand, with a second incision through the diaphragm and pericardium at the apex of the heart. Two or more fingers are introduced through this opening for kneading the heart. Inasmuch as the pleura is unmolested, the results should be better, but in the three cases reported where this method was used, all succumbed.

The subdiaphragmatic method is the simplest and quickest for making the heart accessible for massage. The abdominal incision is made between the ensiform and the umbilicus, the right hand inserted above the left lobe of the liver and the stomach, elevating the immobile diaphragm until the heart is felt. The left hand is placed upon the precordial region for counter pressure. Applying the force steadily, the ventricle can be emptied, the heart diminished in size, and it slips away from the hand. The heart dilates again and is again depleted mainly by compression with the fingers of the right hand. The rate should be from forty to seventy per minute. It seems to facilitate resuscitation by elevating the diaphragm strongly that the fingers may reach well up upon the heart, the higher the better. In successful cases, after a minute or less, a feeble thrill will be felt, a delicate contraction will follow, then a series of fluttering contractions and lastly, definite rhythmical but rapid contractions, with return of the pulse in the radials. It is remarkable with what ease the heart can be palpated and massaged. The dilated stationary heart feels soft and globular, and the first response to massage is noted by an increased density and change of outline.

My experience with this method is necessarily restricted, but I look upon the measure as exceedingly simple, the indication for which, however, requires mature judgment. In any of the methods we must consider such a procedure an extreme measure, because the condition of the patient whose respiration and circulation have ceased is precarious, and because the operation itself cannot be followed with the consummate skill that one of this nature demands. We must consider any method of resuscitation which exposes the heart or abdominal viscera without previous preparation of the part, and the operator's hand, perhaps, a very dangerous one. The indication is met in stasis of the respiration and circulation. Cessation of the respiration alone hardly demands it, unless the abdomen be already open, but conjoined with inhibition of the heart, our duty is clear. I am becoming convinced that if heart massage were used when the abdomen was already opened during cessation of respiration and enfeeblement of the heart, resuscitation of *respiration* would be easier.

We are indebted to d'Halluin for the most lucid explanation of how massage favors resuscitation. It is in three ways:

1. By depletion. In each autopsy of my own, upon animals, the heart was arrested in diastole. The findings in clinical cases are similar, as it is the generally accepted statement that the heart is engorged with venous blood in deaths from chloroform. Heart massage me-

chanically removes this chloroform laden blood, and if artificial respiration has been continued, the fluid which fills the heart chambers contains purer blood each time it is refilled.

2. As a mechanical irritant. It is well known to all physiologists that muscle will respond to chemical, electrical, or mechanical stimuli, and this is true of the heart muscle. Digital compression or manipulation is a stimulus to the muscle and will activate it under favorable circumstances.

3. By realizing an artificial circulation in the coronary arteries. The importance of circulation in the arteries of the heart is manifest, and perhaps plays a great part. The alternate compression and relaxation of the heart with circulation in the aorta cannot fail to impress the coronary arteries. Zezas (45) attributes to the artificial circulation in the heart muscle the success of heart massage. It naturally follows that if we can supply the oxygenated blood with low percentages of chloroform as a substitute for a non-circulating chloroform saturated and carbon-dioxide polluted blood, then the resurrection of the heart is made possible, but unless artificial respiration is maintained, we simply circulate an unchanged noxious blood. I believe also that the sinuses of Thebesius are quite important. Kuliabko has produced rhythmic contractions in the heart of a child dead thirty hours, by perfusing or passing through it artificial or defibrinated blood. The heart of an animal can be removed and contractions inaugurated hours after death by allowing an artificial circulation with Lock's fluid. Whether it is the salts or an enzyme of the blood which excites cardiac action, it is patent that the blood must circulate in order to fulfill its function. That heart massage originates circulation can scarcely be questioned.

Why, on the other hand, does heart massage fail? It is consonant with our theories of the cause of the heart beat to assume that after a brief interval, the muscle cells have undergone such a protoplasmic change that normal constituents of the blood fail to stimulate. We naturally inquire if this change is sudden and simultaneous in all of the cells of the heart. It is not. We detect bundles of muscle fibres which contract fitfully in cases when heart massage is partially or wholly unsuccessful, while other bundles remain quiescent, the irregular action being termed fibrillary contraction or *tremulations fibrillaires* of the French. The cause lies hidden, but it is a common observation that after fibrillary contractions, the recovery of the heart is the exception. Arabian (30) was able to restore seven animals of thirteen, after fibrillary contractions had appeared. The condition may be termed muscular discord. We must look upon this phenomenon rather as an effect than a cause. Crile and Dolley (12) found blood clots in a small number of animals possibly induced by heart massage, and attributed failure to this cause. It is scarcely necessary to reiterate that insufficiency of artificial respiration is properly rated as a cause of failure. Pneumothorax is responsible for some of the deaths. In fourteen of the cases reported, the heart and respiration were revived, but the patients died from one-half hour to twenty hours later. The cause of death in one of Green's cases and one of mine was strongly suggestive of a toxæmia. In neither case was an autopsy performed, but in my case the urine was free from albumen, had a normal percentage of urea, and diacetic acid and acetone were absent. In the only case that came to autopsy, Depage (38) found cardiohepatic insufficiency and œdema of the brain sufficiently pronounced to be considered the logical cause of death. Pike, Guthrie, and Stewart concluded from their experiments that the cortical cells succumb first and recover last. The respiratory and vasomotor centers persist longer and recover earlier. The little data we have at hand would indicate that œdema of the cerebrum makes resuscitation of that organ often an impossibility, with the lamentable results we know too well.

CONCLUSIONS

Heart massage is an established method of resuscitation, ten successful cases having been reported by ten operators.

Heart failure is rarely primary in chloroform anæsthesia, it is therefore essential that respiration be invoked by artificial means in conjunction with heart massage. Artificial respiration alone will not inaugurate heart contractions nor maintain blood pressure.

The best results have been obtained by the subdiaphragmatic method.

The most frequent indication for its use is in chloroform narcosis with cessation of respiration and circulation. In other conditions of heart failure secondary to respiratory failure and not dependent upon organic changes in the heart, the method is applicable. Further use of the method will widen its field of usefulness.

The possibility of resuscitation bears a definite relation to the time that has elapsed between the cessation of the heart beat and massage. The briefer the interval the more rapid is the response to heart massage.

Lastly, let me affirm that the entire question is unsettled, that the fifty cases herein tabulated is only an incentive to further research, that each additional case is of value, and that some time may yet elapse before we can adjust heart massage in proper accord with its surgical bearings.

I am indebted to Prof. Franz, Prof. Phelps, Dr. Elliott, Dr. Hynson, and Mr. McLaughlin, for much kind assistance.

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CHECKING THE SECRETION OF THE LACTATING BREAST

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EVERY one who has experimented with the usual methods of checking the formation of milk in recently delivered women, must welcome a method by which it can be accomplished promptly and with little or no discomfort to the patient.

When Dr. Williams returned from his summer vacation in 1904, he told the obstetrical staff that Dr. Edwin R. Lewis of Westerly, R. I., had for years made use of a simple method of checking the lacteal secretion in women who could not suckle their children for one reason or another. This consisted in the administration of fifteen to twenty grains of acetate of potassium in water three or four times a day, associated with small doses of codia or morphia if the breasts were painful, and had proved so satisfactory that he had not found it necessary to use a breast pump, to apply a binder or to make any medicinal application to the breasts for nearly twenty years. Under this treatment the breasts became more or less acutely engorged on the second, third, or fourth day after labor on the discontinuance of suckling, but that the condition would pass off spontaneously within twenty-four hours if the breasts were left absolutely alone, after which they gradually became softer and smaller and secreted less and less milk, so that the secretion entirely disappeared by the end of a week.

Prior to that time it had been our custom in the treatment of such cases at the Johns Hopkins Hospital, to apply a belladonna plaster to the breasts, which were then thickly covered with cotton and pressed against the thorax as tightly as possible by means of a snugly fitting bandage. When the engorgement became pronounced the latter was removed and the breasts were massaged or emptied of their contents by means of a breast pump. This was repeated as often as necessary, and frequently an interval of several weeks elapsed before the secretion entirely disappeared. In the meantime the patient suffered severely, and often stated that the treatment of the breasts was a more trying ordeal than the labor itself. Moreover the method consumed a large portion of the nurse's time and materially interfered with her other duties.

In view of these facts Dr. Lewis' suggestion was received with considerable skepticism, but as he stated that he had employed the method for many years with excellent results, it was determined to give it a trial. After a short period of probation we found that his statements were fully justified, and later began a series of experiments to determine exactly how the drug acted. Since then the former painful and time consuming method of treatment has been entirely abandoned; not a single woman has been swathed in a pressure bandage, belladonna ointment has disappeared from our drug closet and the art of massaging the breasts is learned by the nurses from books rather than by actual manipulation upon engorged and swollen breasts. Incidentally it may be stated that not a single case of mammary abscess has occurred in our service since this method of checking the lacteal secretion has been in vogue, and has been noted only in patients who suckle their children, or whose breasts had been emptied repeatedly by means of the breast pump before entering the hospital.

In the series of cases upon which this article is based, there were a number of patients who had been delivered prematurely, although the great majority had given birth to full term children. The indication for treatment was usually afforded by the fact that the infants had been still born or had died during the mother's stay in the hospital, although in a considerable number of cases, which were seen in the medical, surgical, or gynecological wards, treatment was required by mothers who had discontinued nursing older children just before entering the hospital. Accordingly, our series of cases comprises patients in all stages of lactation — from that following premature or full term delivery to cases in which it has persisted for some months or even a year. In no instance

did mammary abscesses develop in spite of the fact that some of the women were harboring more or less serious infection. Occasionally one breast was the seat of a mastitis at the time of admission, yet the other would dry up spontaneously under treatment. Indeed it may be stated at this point that the use of the breast pump and massage in the latter group of cases has merely served to prolong the function and activity of the breasts and thus increase the liability to abscess formation, to say nothing of the prolonged pain and discomfort to the patient.

While it is not intended to advocate any new or acceptable idea as to the physiology of lactation, the observation of our cases has shown very clearly that any form of local stimulation prolongs the activity of the mammary glands and it would therefore seem rational to assume that speed, safety, and comfort in checking the process will be most readily and surely obtained by respecting this physiological law.

In this connection, the paragraphs in W. F. Montgomery's "Exposition of the Signs and Symptoms of Pregnancy," which deal with the lactating breast, are both interesting and suggestive, and I would direct attention to several cases to which he refers as showing to how great an extent local stimulation may influence lactation. Thus, he records a case of a girl eight years of age, whom Baudelocque showed before the Royal Academy of Surgery, and whose breasts contained considerable quantities of milk, which was apparently due to the repeated application to her breasts of an infant which her mother was suckling. In an instance quoted from Belloc, a servant girl, who was disturbed at night by an infant which was being weaned, attempted to appease its clamor by applying it to her breasts with the result that their secretion soon became so abundant as to satisfy the child. Reference is likewise made to a grandmother, who at the age of 49 years, twelve years after the birth of her last baby, became the foster mother of her daughter's two weeks' old infant. Many other cases of prolonged lactation are also cited and are attributed to persistent stimulation of the breasts. In one instance, a woman 81 years of age still had a moderate amount of milk in her breasts, and she was reported to have given suck uninterruptedly for 47 years after the birth of her first child, having nursed six of her own children, as well as eight others.

As already stated, the new method was introduced into the lying-in ward with considerable misgivings, but a short trial demonstrated its value. At first it was believed that the action of the potassium acetate was in some way associated with its supposed diuretic action, and accordingly the quantity of fluids was restricted and the bowels kept freely open. In general, our observations were somewhat as follows: On the third day after delivery or after nursing had been discontinued at a later period, but occasionally on the second and sometimes not until the fourth day or later, the breasts would become more or less engorged and occasionally present manifestations of "caking" and exceptionally some lumpiness would even extend into the axilla. This engorgement would persist for twenty-four, thirty-six or occasionally forty-eight hours, and be associated with a varying amount of pain. By the end of this period it would gradually begin to recede, while the pain disappeared immediately after the engorgement had reached its height. During this period the breasts usually became considerably distended, hard to the touch, and often very shiny and glistening, while milk occasionally leaks from the nipples. As the process begins to subside, the secretion gradually becomes less and less in amount, while the breasts become smaller and more and more flabby, so that at the end of a few days and always by the end of the first week lactation has become entirely checked.

In the majority of cases the pain during the period of engorgement is not sufficiently severe to call for the administration of sedatives, and in such cases can be relieved by the application of an ice-cap; although occasionally it will be necessary to give codia or morphia. When the breasts are large and very pendulous they may be held in place by a supporting sling, which simply relieves the weight and dragging, but does not act as a pressure binder.

During the treatment the patient should be cautioned not to handle or massage the breasts, or to attempt to empty them of milk. The ordinary woman is so imbued with the tradition that they must be emptied in order to prevent

serious consequences that it is sometimes very difficult to persuade her to leave them absolutely alone. Moreover, we have observed that the more the patient thinks she knows about herself and her functions, the less willing she is to obey the orders of the physician.

When our observations upon the action of potassium acetate were first begun the amount of fluid ingested was greatly restricted and the patients were purged, unless some contraindications were present. The results, however, proved so favorable that less attention was paid to such details and only ordinary movements of the bowels procured. In view of the very favorable results obtained, it was attempted to find an explanation for the effect of the drug, which, as already indicated, was at first believed to be associated with its supposed diuretic action. Moreover, the possibility was considered that it might exert a selective inhibitory effect upon the secretory functions of the breast cells, or else that it had no effect at all.

With these considerations in mind a series of comparative observations were undertaken in which the intake of fluids by the mouth as well as its output by the urine was carefully studied. In one group the patients were nursing normally, in the second they were not nursing and received potassium acetate, while in the third group they were not nursing but received merely small doses of sodium chloride as a placebo. The analysis of the results obtained in all three groups did not indicate that the acetate of potassium possessed any marked diuretic action, and the fact that it was found that the patients receiving salt solution in its stead did equally well indicated that the former exerted no inhibitory effect. We were therefore forced to the conclusion that the acetate of potassium exerted no particular influence upon the mammary secretion, and all that was necessary in order to check it was to place the breasts absolutely at rest and to leave the process to nature. Since that time the drug has not been employed except in certain cases where it was given merely as a placebo, which was particularly necessary in the neurotic patients in the out-patient department, where they could not be so readily controlled as in the hospital wards.

In connection with the question as to the necessity for the restriction of fluids when it is desired to check the mammary secretion, it is interesting to note that in cases of puerperal infection or of toxæmia of pregnancy, in which the patient is encouraged to drink as much fluid as possible, frequently to the extent of five or six litres a day, no more difficulty was experienced in drying up the breasts, than in perfectly normal women who had lost their children.

The idea of leaving the breasts absolutely alone, and allowing nature to pursue her own course in checking lactation, is not altogether new, as it would appear that a century and a quarter ago Dr. Charles White [1] of Birmingham, England, in his monograph upon milk-leg, as well as in the third edition of his treatise on the "Management of pregnant and lying-in women, and the means of curing, but more especially of preventing the possible disorders to which they are liable, etc.," stated "If the patient does not suckle her child no method should be used either to recall the milk or to invite it into the breasts, but she should be left entirely to nature; she should live very abstemiously, little or no animal food, no strong liquor should be allowed her, and the intestinal canal should be left thoroughly open."

This was written in 1785, and although the writers of the earlier American text-books almost without exception said nothing on the subject, the more recent authors have seemed to vie with one another in suggesting ways and means of checking the mammary secretion by other than the physiological one of leaving the breasts absolutely alone. Some have suggested that the secretion might cease spontaneously, but were apparently afraid to treat the period of engorgement expectantly and to give anodynes when necessary, but instead have advocated the use of the breast pump and massage in the attempt to prevent its occurrence. Accordingly the ordinary text-books on obstetrics and nursing usually picture many varieties of complicated breast binders and bandages, advocate several systems of massage, while various external and internal medicaments have each their champions and scoffers.

Upon looking over the literature upon the subject, it is interesting to note how some

[1] A Treatise on the Management of Pregnant and Lying-in Women. London, 1785.

phases of it have grown under the hands of the busy physician. Thus in a communication to an old number of the London Lancet for August 6, 1856, one practitioner told how he found the pressure bandage of the greatest possible value in drying up the milk; while a few months later another writer stated that the combined use of the pressure bandage and belladonna ointment gave much better results. As time went on the number of recommendations increased, and everyone appeared to have something new to offer, so that at the present time a mere list of the suggestions made is bewildering and affords convincing evidence that the vaunted treatment was either inefficacious or useless, or both.

Some idea of the multiplicity of the suggestions may be gained from the following which have been culled from a few sources: Pressure with or without various ointments and lotions, is quite a general expedient; emptying the breasts when full by massage or pump or some other suction apparatus is an extremely important procedure to many minds. Others advocate exciting uterine discharge or bleeding by the intrauterine application of caustics, galvanism, or warm douches, although such procedures would seem of questionable value or even dangerous. The application of electricity to the breasts and nipples has likewise been offered as an innocuous expedient. The restriction of fluids and diet may appear rational, but is unnecessary; while purgation by means of tartar emetic, salines, or Weiss "petit lait" — a concoction of vegetable purgatives — is also more drastic than necessary. External applications to the breasts and nipples, such as belladonna ointment, lead water and laudanum, cocaine solutions, as well as lotions of many varieties have been frequently recommended; although instances of poisoning have occasionally been attributed to each of them. Others have suggested various fomentations and poultices, and while a poultice made of chopped parsley may appeal to the æsthetic sense it could certainly have but little intrinsic value. Application of cups to the back is suggested in one of the works on midwifery. This suggestion appears to have been based in part upon the right principle, in that it leaves the breasts alone; but at the same time it would seem to be a too rigorous procedure, when nothing is required. Numerous internal medicaments have also been suggested, such as sage tea, infusion of periwinkle or borage, atropine, tincture of belladonna, iodide of potassium, ergot, chloral, and antipyrine, as well as decoctions of reed or dog grass with nitre, hemp seed oil, etc.

In addition to the employment of the various procedures and remedies just indicated, the great majority of writers upon the subject insist upon the necessity of keeping the breasts empty of milk, either by pressure or by draining them through the nipple, but in the light of our experience such a procedure is absolutely unnecessary and is occasionally associated with serious danger.

Following our preliminary observations in the autumn of 1904, and the establishment of the fact that the acetate of potassium is of no therapeutic value in checking the mammary secretion, the following method has been employed as a matter of routine in all cases in the obstetrical department of the Johns Hopkins Hospital, as well as in the private practice of Doctors Williams, Slemons, and Goldsborough, whenever it was desired to dry up the breasts.

When the child is born dead, or suckling contraindicated for any reason, the breasts are left absolutely alone for the days immediately following labor. Ordinarily they become considerably engorged about the third day, and occasionally quite painful; the patient, however, is told that the swelling and pain will promptly disappear and that no treatment is necessary. Within the course of 24 or thirty-six hours, the swelling begins to subside, after which the secretion gradually diminishes in amount, to disappear entirely before the end of the week. When the breasts are large and pendulous, a loosely fitting bandage is applied to keep them from sagging, but not to exert pressure, and probably once in twenty cases a single hypodermic of morphia or codia may be necessary to relieve pain during the period of active engorgement.

During the past four years we have entirely abandoned the use of the breast pump, belladonna plasters, and tight breast bandages and have been delighted to see the mammary secretion disappear more rapidly and with far less discomfort to the patients than were before.

The head nurse, who was on duty during the transition period, naturally regarded the change with great skepticism, but within a few months was obliged to confess that there was no comparison between results following the old and the new methods, and stated that by doing away with the use of massage and the breast pump she was able to dispense with the services of one nurse for the routine work of the ward.

For the past year this method has become so much a matter of course that accurate notes have not been made upon the results obtained by its means; but during the period of probation daily notes were made concerning the condition of the breasts. During the former period 171 cases were carefully observed — 107 in the ward and 64 in the out-patient department — which were equally divided between primiparæ and multiparæ. In 45 per cent of the cases pregnancy terminated before its normal end, while in 55 per cent labor occurred at full term. In all cases the secretion was checked as described above, and in no instance did a mammary abscess develop, nor has such an occurrence been noted in our later cases.

We feel that this conservative method has been thoroughly tested in our service, and therefore have no hesitation in recommending its general use. Its development affords an interesting example of the value of experimental methods in clinical work and clearly shows that nature, if left alone, is frequently able to accomplish more than the pharmacœpia, and that great caution is necessary in offering a judgment as to the value of supposed therapeutic procedures.

WHAT IS THE PREFERABLE TIME FOR ABDOMINAL OPERATION FOR A CHRONIC INFLAMMATORY MASS IN PELVIS?

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IN a considerable proportion of the cases of chronic suppuration in the pelvis, the pus is sterile at the time of operation.

In 684 cases examined bacteriologically (collected by Andrews (1) and comprising series by Charrier, Hartman and Morax, Kelly, Koch, Legros, Martin, Menge, Orthmann, Prochownik, Beichel, Schaffer, Schauta, Schenk, Schmitt, Stemann, Strassmann, Wertheim, Westermark, Whiteside, Witte, Zweifel, Rist, Mackenrodt, Durck, Bellei, Walsh, Frommel, and Andrews) the results, excluding tubercular cases, were as follows:

	Per cent
Sterile	55.
Only saprophytes	6.
Gonococcus	22.5
Streptococcus and staphylococcus	12.
Pneumococcus	2.
Bacillus coli communis	2.5

In a later resume, by Hyde (2), comprising nearly three thousand cases (2,973 cases, excluding tubercular), the bacteriologic findings were approximately as follows: sterile, 1,998; gonococcus, 579; other bacteria and mixed infections, 456.

It is interesting to note the steps in the development of this knowledge. Long ago it was observed that, of the patients subjected to abdominal operation for pelvic suppuration, the old cases usually recovered promptly, while the recent cases frequently developed fatal peritonitis — that is, operation in the acute stage was far more dangerous than operation in the chronic stage. The splendid advance n gynecologic work in the last two decades is based on facts ascertained in two ways. Some facts came to the surface largely through pathologic and bacteriologic investigation, while others were ascertained by experience at the operating table and the bedside. The fact above referred to belongs to the latter class. It was learned by experience, often bitter experience, and many

lives were lost before the lesson was fully learned.

This fact, after having been clinically established, was the occasion of much curiosity, as the explanation was not at hand. It seemed paradoxical that long continuance of a debilitating disease should put the patient in better condition for a serious operation for the same. What could be the explanation? Why did chronic inflammation confer such immunity from peritonitis after operation? One early theory was that the immunity was due largely, if not wholly, to the local effect on the adjacent peritoneum, choking its absorptive channels so that serious septic absorption could not take place so readily, and modifying the membrane so that it was not as good culture ground for the bacteria. According to another hypothesis, the body resistance generally became "accustomed" to the local irritation in the pelvis and consequently was less disturbed by the added irritation of operation, and also, owing to the preparedness, so to speak, of the general resistant forces of the body, they were better able to combat invasion. These explanations were but gropings in the dark, but nevertheless they contained truths which have been verified and elucidated by the epoch-making investigation into the resistant functions of the leukocytes and the blood-serum and into the modus operandi of antitoxin and vaccine therapy.

The decisive step in the solution of the riddle was the inauguration of systematic bacteriologic examination of specimens removed in operations for pelvic suppuration. These bacteriologic examinations were undertaken primarily for the purpose of determining the etiology of salpingitis, particularly what proportion of the cases was due to the gonococcus and what proportion to other bacteria. The results were disappointing. In a considerable proportion of the cases no bacteria could be found, and hence in these cases the etiology of the trouble could not be bacteriologically determined. But, though disappointing so far as concerned the definite etiological classification of cases, the facts thus ascertained were very illuminating in regard to the important and puzzling question as to why immunity was secured by waiting. In many cases the bacteria had died and disintegrated and the pus was sterile — that was the reason why serious inflammation seldom followed abdominal section for old tubal abscesses, even though considerable pus often escaped among the pelvic structures during enucleation. On the other hand, in fresh cases the least peritoneal contamination by the contained pus was often followed by fatal peritonitis, because the bacteria were not dead, but active and virulent. Another fact ascertained was that in many of the old cases in which bacteria were still present, they were so attenuated that the pus was practically sterile.

PERSISTENCE OF VIRULENCE; CLASSIFICATION OF CASES

It having been established that sterilization gradually takes place within a reasonable time in most cases, the next problem is to determine the *period of time* required for this automatic sterilization or effective attenuation in the different classes of cases.

The persistence of virulence depends largely on the character of the infection. The two principal infectious agents in pelvic inflammatory masses are the gonococcus and the streptococcus. These two differ widely in the persistence of virulence and also in certain clinical characteristics which can be distinguished before operation.

For the purpose then of considering the persistence of virulence in a practical way, i. e., as a guide to treatment, the cases of chronic pelvic suppuration (tubercular excluded) may be divided into two classes — the gonococcic and the streptococcic. To be useful, this classification must be made before operation, that is, it must be a clinical rather than a strictly bacteriological classification. Of course, from a bacteriologic standpoint there are other cases (due to other bacteria), but in the present state of knowledge these other cases can not, as a rule, be distinguished before operation, and even if they were distinguished, not enough information has accumulated to show the average persistence of virulence in such cases. Consequently, when confronted with a case of non-tubercular chronic pelvic inflammation, the endeavor should be to decide whether it belongs to the

gonococcic or the streptococcic class, ignoring for the time the fact that it may possibly be due to other bacteria which in point of virulence lie between these two extremes.

How may the gonococcic and the streptococcic cases be distinguished before operation? What diagnostic facts are available at that time? Bacteriologic examination of the urethral or uterine or other discharge is of assistance in only a small proportion of these chronic cases, for as a rule, the bacteria have disappeared from the discharge. Neither is there at present any well established specific diagnostic reaction in gonococcus or streptococcus cases corresponding to the tuberculin reaction in tubercular cases. Hence we must depend on other information obtainable before operation. Fortunately the gonorrhœal cases and the streptococcal cases differ usually in two particulars, namely, (*a*) in the apparent cause of the trouble and (*b*) in the location of the lesion. As a rule these distinguishing points may be settled and the case definitely classified, by an accurate inquiry into the onset of the trouble and a careful bimanual examination.

Uncertain cases are to be classed with one or the other, as the preponderance of evidence warrants, and are to be given treatment accordingly. After operation, bacteriologic examination may show other bacteria either alone or associated, and, if accurate records are kept of the histories and bacteriologic findings in large series of cases, it may be possible later to form a third clinical class, comprising one or more of the miscellaneous or mixed infections. For the present, however, the two classes, gonococcic and streptococcic, are all that can, as a rule, be satisfactorily distinguished before operation.

GONOCOCCIC CLASS (*Clinical*)

In the gonococcic cases (clinical) the distinguishing points are (1) that the pelvic inflammation is preceded by evidences of gonorrhœa or comes on without apparent cause, and (2) that the lesion is located in the tube, extending thence to the ovary or adjacent peritoneal surfaces, but not involving the connective tissue (parametrium) to any decided extent. As so much diagnostic importance is attached to these two points, it is necessary to consider them somewhat in detail.

1. *Apparent cause or mode of onset.* As a general proposition it may be said that the gonococcus is the only germ that will spontaneously invade the normal non-puerperal uterus and tubes. There are exceptions. Riedel (3) reported that of 56 girls under ten years of age operated on for appendicitis, five had peritonitis due, not to appendicitis, but to acute salpingitis. He states positively that the infection reached the tubes by way of the vagina and uterus, and that gonorrhœa was excluded in every case. Cultures showed the ordinary pus germs. The inflammation was virulent and every patient died in spite of operative treatment. He observed the same clinical picture in two girls past ten years of age, both of whom died. In contradistinction to these cases in children, he states that he has never seen such penetration of normal genitalia by streptococci or staphylococci in the adult.

General experience is in accord with this statement in regard to adults. Purulent inflammation of the vagina or uterus beginning spontaneously and later extending out into the pelvic cavity, may be set down as almost certainly gonorrhœal. The patient must of course be questioned closely enough to eliminate an early miscarriage and also any intrauterine instrumentation (curettement, intrauterine treatment, sounding in examination, etc.). The probability of gonorrhœa is increased if the purulent discharge (free leucorrhœa) began within a few weeks after marriage. Again, in a large proportion of the cases of gonococcal leucorrhœa there is urethritis, causing burning on urination and increased frequency of urination. This discharge and disturbance of micturition may last a few days or much longer. It may precede the pelvic inflammation by a few days or a few weeks or a few months. A history of abscess of one of the vulvo-vaginal glands has about the same significance as a history of urethritis. These structures are frequently involved in gonococcal leucorrhœa but very seldom in leucorrhœa from other causes.

In those cases where the vaginal and uterine gonorrhœa did not cause sufficient disturbance

to be noticed, the pelvic inflammation began without apparent cause. A considerable proportion of the gonorrhœal cases give such a history. Here again one must be careful not to overlook an early miscarriage or some intrauterine instrumentation. Also, it is important to trace the inflammation back to its very beginning, for some cases of puerperal infection are very mild in outward manifestations and do not cause very much trouble until there is an exacerbation after several weeks or months. In these cases, however, there is usually a history of some disturbance during the puerperium from which the patient recovered to a large extent but not entirely. On the other hand, an inflammatory trouble at first apparently due to a miscarriage or full term delivery, may on careful questioning be found to antedate the pregnancy and to be due to a preceding gonorrhœal infection.

In the examination, a search should be made about the external genitals for evidences of an old gonorrhœa. Signs of previous inflammation of the urethra or of the vulvo-vaginal glands may be found, such as red spots (maculæ gonorrhœæ) in these situations or secretion that can be pressed from the structures. Bacteriologic examination of discharge from the urethra, vulvo-vaginal glands, vagina, or cervix may show gonococci. Negative findings, however, do not exclude gonorrhœa, for in many of the chronic cases the causative bacteria have disappeared from the discharge.

In a certain proportion of cases of gonococcic pelvic inflammation, the extension of the gonococci into the uterus and beyond took place during the puerperium. It has been shown that the gonococcus may lie practically dormant in the lower part of the genital tract for a long time and extend upward after a labor or miscarriage. Sanger (4) examined 389 pregnant women and found the gonococcus in 100. Steinbuckel (5) examined the lochia in 274 women in which the puerperium was normal and found the gonococcus in 18 per cent. In Leopold's (6) clinic, 25 per cent of the puerperal infections were of gonorrhœal origin. In 179 cases of puerperal sepsis examined bacteriologically by Kronig (7), 50 cases were gonococcal, 50 belonged to the sapræmic group (miscellaneous saprophytes, most of which did not grow in ordinary culture media) and 79 were due to the ordinary pus bacteria. Puerperal infection due to the gonococcus is nearly always of a mild type, as shown in an interesting article by Taussig (8). A history indicating that the attack of puerperal sepsis was mild, may help some in differentiation, though it must be kept in mind that puerperal infection from other bacteria may also run a mild course. In the cases of puerperal origin, therefore, without positive evidence of gonorrhœa, the decision must rest largely on the location of the lesion.

2. *Location of the lesion.* The extension of gonorrhœal inflammation is almost invariably along the uterine mucosa into the tube, and any further extension is toward the ovary and the peritoneal cavity. Gonococci very seldom extend through the uterine wall into the parametrium. Even when they do extend into the connective tissue, they are not likely to form an inflammatory mass there. Steinschneider (9) and Schæffer injected pure cultures of gonococci into the connective tissue, but no decided inflammatory reaction resulted. Though parametrial abscess may occasionally result from gonococci, as demonstrated by Wertheim (10) and others, it is so rare as to be a curiosity.

The characteristic lesion, therefore, of gonorrhœa in the pelvis, is pyosalpinx, with or without the complicating oophoritis and pelvic peritonitis. The great majority of all pus tubes are due to gonorrhœal infection, known or unknown. In 106 cases of purulent salpingitis examined by Menge (11), the findings were as follows: sterile pus in 68, gonococci in 22, tubercle bacilli in 9, staphylococci in 1, anærobic bacteria in 2, and streptococci in 4. As we shall see later, the gonococcus often dies out within a comparatively short time, so it is probable that most of the sterile cases originate from the gonococcus. When this fact is taken into consideration it becomes apparent what a large proportion of the cases of purulent salpingitis are due to the gonococcus and what a small proportion to other bacteria.

The accompanying table of cases of the gonococcic class (clinical) shows the two principal diagnostic points before operation, the interval

TABLE OF CASES OF GONOCOCCIC CLASS (CLINICAL), SHOWING DIAGNOSTIC POINTS AND PERSISTENCE OF VIRULENCE

Case and Ref. No.	Cause and Time of Onset	Examination	Operation and Findings	Bacteria	Convalescence
1 [12]	Cause, gonorrhœa. Time of onset uncertain. Severe symptoms for two weeks.	Retrodisplacement and tubo-ovarian mass.	Laparotomy. Pus tube (right) and retrodisplacement.	Gonococci.	Prompt recovery
2 [12]	Cause, mild sepsis following labor. Began 10 mos. before operation.	Tubo-ovarian mass in each side. Urethral discharge showed gonococci.	Laparotomy. Large pyosalpinx (R.) and salpingitis (L.)	Gonococci in pus from tube.	Prompt recovery
3 [12]	Cause, abortion 1½ years before operation. Suspicion of gonorrhœa before abortion. Husband had some discharge.	Retrodisplacement and tubo-ovarian mass on each side.	Laparotomy. Retrodisplacement. Right tubo-ovarian abscess. Left salpingitis.	No bacteria in surgery cultures or tissue secretions.	Prompt recovery
4 [12]	Cause, gonorrhœa began 3 yrs. before operation.	Tubo-ovarian mass on each side.	Laparotomy. Pyosalpinx (R.) large. Salpingitis (L.)	Staphylococci.	Recovery.
5 [12]	Cause, gonorrhœa immediately after marriage. Began 5 yrs. before operation.	Tubo-ovarian mass.	Laparotomy. Tubes involved on each side.	Gonococci.	Recovery.
6 [12]	Cause, gonorrhœa began 6 mos. before operation.	Tubo-ovarian mass on each side.	Laparotomy. Double salpingitis.	Gonococci.	Recovery.
7 [12]	Cause, gonorrhœa at marriage. Began 3 yrs. before operation.	Adnexal mass.	Laparotomy. Pyosalpinx.	Gonococci.	Recovery.
8 [12]	Cause, not certain. Began about 1 yr. before operation.	Pelvic inflammation (chronic) associated with a fibroid.	Laparotomy. Removal of fibromyomatous uterus and a pyosalpinx	Sterile.	Recovery.
9 [12]	Cause, gonorrhœa. Began 2 weeks before operation.	Acute general peritonitis. Pelvic findings on exam. not stated.	Laparotomy. General peritonitis. Double salpingitis. Both tubes discharging pus.	Gonococci.	Recovery.
10 [13]	Cause, gonorrhœa. Began 2 weeks before operation.	Peritonitis. Gonococci in vaginal discharge.	Laparotomy. Peritonitis general. Pus in both tubes.	Gonococci.	Recovery.
11 [14]	Cause, gonorrhœa. Began 1 month before operation.	Bilateral tubo-ovarian mass, and peritonitis.	Laparotomy. Pus in both tubes. Peritonitis.	Gonococci.	Recovery, complicated by inflammation of ovary.
12 [15]	Cause, gonorrhœa just after marriage. Began 2 yrs. before operation.	Right pyosalpinx. Left salpingo-oophoritis.	Laparotomy. Removal of adnexal masses.	Sterile.	Recovery.
13 [16]	Cause, sepsis from labor. Began 1 year before operation.	Left adnexal mass. Diag. pyosalpinx.	Laparotomy. Pyosalpinx (left) and adhesions.	Gonococci.	Recovery.
14 [17]	Cause, gonorrhœa. Began 2 weeks before operation.	Adnexal mass in each side.	Laparotomy. Bilateral pyosalpinx.	Sterile.	Result not stated
15 [18]	Cause, uncertain. Began 3 yrs. before operation.	Not stated.	Laparotomy. Double pyosalpinx.	Sterile.	Not stated.
16 [19]	Cause, uncertain. Began 5 wks. before operation.	Right adnexal mass.	Laparotomy. Extirpation, right ovary and tube. Pyosalpinx.	Sterile.	Not stated.
17 [20]	No cause apparent. Time of onset not stated.	Adnexal mass on each side.	Total vaginal extirpation. Uterus removed, but tubes broken and part left. Double pyosalpinx, adherent.	Gonococci.	Death from purulent peritonitis, showing typical gonococci.
18 [21]	Cause, gonorrhœa. Infection apparent in husband. Began 2 months before operation.	Double salpingitis.	Laparotomy. Removal of both adnexa.	No exam.	Chill on 3d day, followed by fever. Arthritis, pyæmia, endocarditis. Death 15th day. No peritonitis.
19 [22]	No cause apparent. Had influenza 1 yr. before operation. Married 5 mos. before operation	Adnexal masses. Diag. double pyosalpinx.	Laparotomy. Double pyosalpinx.	Staphylococci.	Result not stated
20 [23]	Cause, sepsis from labor. Time of onset not stated.	Left adnexal mass size of fist.	Laparotomy. Pyosalpinx (left). Burst in removing.	Gonococci and staphylococci.	Recovery.
21 [23]	No cause apparent. Began only a few weeks before operation.	Adnexal mass in left side.	Laparotomy. Pyosalpinx (left). Broke in removal.	Pneumococci.	Result not stated.
22 [24]	Cause, apparently gonorrhœa. Came on just after marriage. Began only a short time before operation.	Adnexal mass on each side, and extending into cul-de-sac.	Vaginal puncture. Pus in cul-de-sac and also in tubes. Supposed to be gonorrhœal.	Pneumococci only.	Recovery.
23 [25]	Cause, followed typhoid fever, 12 yrs. before. Began 12 yrs. before operation.	Not stated.	Laparotomy. Right pyosalpinx.	Typhoid bacilli.	Result not stated.

of time from infection to operation, the bacteria found at operation, and the degree of virulence (as indicated by the result of the operation).

The gonococcic cases tabulated in detail may be taken as typical of the hundreds of cases of this common class, which includes probably four-fifths of the chronic inflammatory masses in the pelvis. These cases are so common and run such a uniform course that but few are reported in sufficient detail to show definitely the apparent cause, the interval of time from infection to operation, the location of the lesion, and the bacteriologic findings. It would be well if several series from the larger clinics were reported so as to show the points mentioned, that the pre-operative diagnosis of the character of the infection and the probable virulence may be more clearly defined.

It will be noticed that in some of the cases belonging clinically to the gonococcic class, bacteriologic examination showed other bacteria instead of the gonococcus. But they are placed in this clinical class because of the apparent cause and the location of the lesion — the only decisive information usually obtainable before operation. It is only by such careful classification of the cases before operation and careful bacteriologic examination after operation, that a useful classification can be established and errors gradually eliminated.

The lessons to be drawn from the consideration of the cases of the gonococcic class (clinical) may be stated briefly under three heads, as follows:

Reliability of the diagnostic points available before operation. From the cases here cited, which are typical of the hundreds belonging to this class, it is evident that the two points mentioned (the apparent cause and location of the lesion) may be depended upon to eliminate the virulent streptococcal cases. Where these two clinical signs agreed, bacteriological examination of the pus showed either the gonococcus or absence of bacteria, with but one exception. This exceptional case was rather acute and appeared gonorrhœal. The trouble began shortly after marriage with a purulent vaginal discharge and local irritation. The discharge was not examined bacteriologically. An adnexal mass appeared on each side and extended into the cul-de-sac. The pus pockets in the pelvis were evacuated by vaginal incision. Pus was found in the cul-de-sac and in both tubes. It was supposed to be gonorrhœal. Bacteriologic examination showed pneumococci in abundance, but no gonococci.

In the cases where the two points did not agree, there were various bacteriological findings. In uncertain cases the location of the lesions was principally depended upon for classification. Except where the trouble was clearly from puerperal sepsis, a marked tubo-ovarian mass without parametrial involvement, admitted the case to this class. In no instance did such a case show streptococci. In the cases due to puerperal sepsis great care should be exercised in excluding streptococci before admitting the case to the gonococcic clinical class. The apparent location of the lesion helps, but cannot yet be depended upon entirely in these puerperal cases. A few cases showing streptococci presented masses at first supposed to be purely adnexal (see Table II). Most of these, however, on more thorough examination at the time of operation, showed that the process was located partly in the connective tissue. Streptococcal pyosalpinx without associated parametritis is certainly very rare. Miller (26), who reported a number of streptococcal infections and investigated bacteriologically more than a hundred cases of pelvic inflammation at Johns Hopkins Hospital, stated that he had never encountered a frank pyosalpinx due to the streptococcus. Whiteside and Walton (27) in a series of thirty cases of pyosalpinx examined for bacteria, found the streptococcus in three, but the question of coincident parametrial involvement does not seem to have been investigated. In a a series of 106 cases of suppurative salpingitis, Menge (11) demonstrated the streptococcus in 4, but nothing definite is said as to the parametrial involvement in these cases.

Persistence of virulence. In the clearly gonococcic cases the bacteria were found absent or attenuated, as a rule within two to four months after infection. In some cases gonococci were found after several months or a year or even several years, but they had lost their virulence. Hartman and Morax (28) state that all their specimens showing gono-

cocci were from patients with rather recent inflammation, the duration of the trouble varying from three weeks to four months, and averaging 4 to 5 weeks.

Gonococci may die and disappear within a few weeks. In two cases in the table, where examination of the pus showed it to be sterile, the duration of the trouble was only two months in one case and five weeks in another. Gonococcal pus confined in the tube may become sterile in six or eight weeks, but it may, on the other hand, continue active for a considerably longer time. Radical operation, therefore, should ordinarily be postponed to at least three months from the onset of the trouble.

Why wait for sterilization or attenuation in gonococcal cases? There are two reasons. In the first place, a considerable proportion of the pelvic inflammatory masses disappear without operation if nature is given a chance for three or four months. Many cases of supposed pyosalpinx so recover. The expression "supposed pyosalpinx" is used advisedly. I do not care to enter into the controversy over the possibility of the spontaneous cure of pyosalpinx, hence I limit my statement to the inflammatory masses "supposed" to be pyosalpinx, of which undoubtedly a considerable proportion disappear when nature is given a reasonable chance.

The second reason for waiting for automatic sterilization or effective attenuation of the pus within the quiescent mass, is that active gonorrhœal pus is not by any means harmless. General peritonitis due to the gonococcus is not so rare as formerly supposed. Hunner and Harris (13) collected eighteen cases supported by bacteriological proof, and seven of these patients died. They found also twenty-one cases in which, though bacteriologic proof was lacking, the clinical evidence indicated strongly that the peritonitis was gonococcal, and five of these patients died. Again, peritonitis is not the only danger from operating on a quiescent but still active collection of gonorrhœal pus. Price (21) reports a case in which such an operation caused general dissemination of the bacteria, with involvement of the joints and endocardium and finally death fifteen days after the operation. There was no evidence of peritonitis. A number of cases of general dissemination of the gonococcus have been reported. Hunner cultivated gonococci from the blood taken from the arm of a patient five days after abdominal section for supposed gonococcal peritonitis, and in a fatal puerperal case Harris and Dabney (29) demonstrated gonococci on the valves of the heart.

STREPTOCOCCIC CLASS (*Clinical*)

The distinguishing characteristics are (1), the apparent cause of the trouble, and (2), the location of the lesion.

1. *Apparent cause.* Nearly all the streptococcic inflammatory masses in the pelvis can be traced to sepsis following labor or miscarriage. In the adult, streptococci do not spontaneously penetrate the non-puerperal uterus. Aside from labor or miscarriage, streptococcus infection may be due to curettement or other uterine operation, to intrauterine application or sounding, to a stem pessary, to abnormal conditions caused by cancer or fibroid, or chronic inflammation. If a pelvic inflammatory trouble can not be traced to one of the causes above mentioned it is almost certainly not streptococcic. In taking the history care must be exercised not to miss an early miscarriage or an intrauterine treatment. Care must be taken also to trace the trouble back to its very beginning, otherwise an exacerbation remote from the causal miscarriage or labor may be mistaken for the beginning of the trouble.

On the other hand, not all puerperal cases are streptococcic. About 25 per cent of puerperal infections are gonococcal. They are usually of a mild type and subside quickly, but it must be kept in mind also that other puerperal infections (staphylococcic and even streptococcic) may run a mild course. Consequently the mildness of the preceding septic attack must not be given too much weight. Outside of external evidences of gonorrhœa (about the vulva or in the discharge) most dependence is to be placed on the location of the lesion. Streptococcus lesions are usually parametrial while gonococcus lesions are usually tubo-ovarian.

Another complicating factor in these puerperal cases is that there may be a mixed infection, causing both kinds of lesion to be present. Stone and McDonald (30) reported such a case. This case furnished also a beautiful and striking illustration of the fact that the gonococcus spreads by way of the mucous membrane and the streptococcus by way of the connective tissue. The gonococci occupied the right tube and extended from thence into the peritoneal cavity, while the streptococci occupied the right broad ligament and extended from thence into the peritoneal cavity where the two forms of bacteria met. Another possibility in these puerperal cases is that the two forms of bacteria may be mixed in one lesion, e. g., in a pyosalpinx. This is evidently very rare but it has occurred, and the possibility of it should make us always suspicious of a post-puerperal inflammatory mass wherever located. In such a case the evidences for and against the presence of streptococci should be most carefully canvassed before deciding to subject the patient to abdominal section.

2. *Location of the lesion.* A chronic lesion in the pelvis, of streptococcic origin, is nearly always in the connective tissue (parametrium). Unlike the gonococcus, the streptococcus does not progress along the mucosa into the tube, but penetrates the wall of the uterus and extends into the connective tissue. It not infrequently extends from the connective tissue to the peritoneum, causing peritonitis. Of course, in exceptional cases, streptococci may pass from the uterus into the tube, but in such cases they are likely to pass on through the tube and cause fatal peritonitis. Consequently in the streptococcic cases that survive the acute attack and come later for treatment for an inflammatory mass, the lesion nearly always involves the connective tissue (parametrium). As before mentioned, Menge found the streptococcus in four cases of pyosalpinx, while Whiteside and Walton found it in three, but parametritis was not excluded. The last mentioned authors endeavored to produce streptococcus salpingitis experimentally by injecting into the uterus in rabbits pure cultures of streptococci and also mixed cultures of streptococci and staphylococci. In no instance did salpingitis result. One rabbit died of streptococcus septicæmia while the others simply developed a purulent vaginitis for a few days and then recovered, and when replaced in the rabbit pen became pregnant and bore litters of six rabbits each. Miller (31) in the bacteriological examination of 127 cases of pelvic inflammation found the streptoccus 7 times, but in no case was the lesion a pyosalpinx alone. There are very few exceptions to the rule that streptococcal masses in the pelvis are parametrial in whole or in part.

Are all parametrial inflammatory masses streptococcic? Nearly all. That parametrial suppuration is usually due to the streptococcus is substantiated by Rosthorn, Bumm, Doleris and Bourges, West, Cullingworth and others. Hartmann and Morax found it in 21 cases of parametrial abscess. In every such case operated on by Fritsch, the streptococcus was found to be the cause. It is only occasionally that staphylococci and other bacteria are found either alone or associated with the streptococcus. As parametrial inflammation is nearly always due to the streptococcus, every case presenting a parametrial mass should be placed in the streptococcic class until it is definitely proven to be due to some other cause.

The distinguishing characteristics of a parametrial mass (chronic) are: (*a*) its situation in the connective area, usually in the broad ligament; (*b*) its low situation in relation to the uterus, often coming down beside the cervix; (*c*) its intimate blending with the uterine wall, as though it were a part of the same; (*d*) its intimate blending with the pelvic wall, as though it were an outgrowth from that structure; and (*e*) its hardness, often being so hard as to simulate a cartilaginous or bony tumor growing from the pelvic wall. A tubo-ovarian mass, on the other hand, is distinguished by its being situated high, in the tubo-ovarian region, or prolapsed into the cul-de-sac; by its not blending so intimately with the uterine wall, a distinct groove usually marking the point where the two come in contact; by its not blending so closely with the pelvic wall; by its presenting to the examining finger a portion of the rounded outline of the tube or ovary; and by the absence of

the cartilaginous hardness often seen in chronic parametrial masses.

The accompanying table of cases of the streptococcic class (clinical) shows the two principal diagnostic points before operation, the interval of time from infection to operation, the bacteria found at operation and the degree of virulence (as indicated by the result of the operation).

From this table of the streptococcic class (clinical) the following facts may be adduced:

Reliability of the two diagnostic points available before operation. When the history showed that the trouble originated from labor or abortion and the examination showed a well marked parametritis, streptococci were found in every case except one. This one exception (case 16) was Hunner's case, and he was not altogether satisfied with the bacteriologic examination, but stated that he regarded the case as streptococcal in spite of the negative findings.

When the two points do not agree, then the principal weight should be given to the location of the lesion. But not a sufficient number of carefully observed cases has accumulated to define accurately how great a dependence may be placed on the location of the lesion in these uncertain cases. This is a point to be further investigated. For the present these uncertain cases should be considered with great care in order that no streptococcic case be allowed to slip into the gonococcic (abdominal section) class.

Persistence of virulence. The virulence of the streptococcus persists indefinitely. Miller reports one case in which the bacteria persisted for six years and another in which they persisted for twelve years. Martin (39) states that streptococci have been found fully virulent in a pelvic inflammatory mass after nineteen years. In one instance (Case 19) streptococci apparently disappeared in six months, but the pus also disappeared. The case was one of severe sepsis following labor. On the eighth day, vaginal incision into a pelvic abscess evacuated pus containing streptococci. Six months later, a mass persisting, a vaginal incision was made into the cul-de-sac and the mass. No pus was found but there was serous fluid showing staphylococci alone.

Automatic sterilization of a streptococcus abscess is perhaps possible but it is so rare that it is not to be counted on. A streptococcal mass in the pelvis is always dangerous, and abdominal section for the same at any time is likely to be followed by a fatal peritonitis. The cases above tabulated give striking proof of the seriousness of intraperitoneal operation in these cases.

Character of operation. The only safe way to operate for streptococcal pus collection is by the extraperitoneal method. If possible the pus collection should be reached and evacuated per vaginam. If this can not be accomplished it may be practicable to drain the abscess by extraperitoneal operation above Poupart's ligament, as was done in some of the cases above cited. Intraperitoneal operation in these cases should be undertaken only when the patient's life is threatened by the severity of the inflammation and it is impossible to reach the mass in a less dangerous way.

CONCLUSIONS

1. In more than half of the cases of chronic suppuration in the pelvis, the pus is sterile at the time of operation — showing that sterilization of the infected focus takes place automatically within a reasonable time in the majority of cases.

2. Abdominal removal of the mass while the bacteria are active and virulent results in fatal peritonitis or localized infection in many of the cases. Abdominal removal of the mass after the bacteria are dead or greatly attenuated, is almost never followed by infection, even though there is an extensive escape of pus into the pelvis.

Hence abdominal operation for a chronic inflammatory mass in the pelvis should not be undertaken before the period of probable sterilization, except in those rare cases in which, in spite of palliative measures, the patient's life is threatened by the severity of the inflammation and the infected focus can not be satisfactorily drained extraperitoneally.

3. The time required for the death of the bacteria or effective attenuation of the same varies greatly in different cases. The persistence of virulence depends largely upon the character of the infection. The two in-

TABLE OF CASES OF STREPTOCOCCIC CLASS (CLINICAL), SHOWING DIAGNOSTIC POINTS AND PERSISTENCE OF VIRULENCE

Case and Ref. No.	Cause and Time of Onset	Examination	Operation and Findings	Bacteria	Convalescence
1 [29]	Cause, sepsis from labor. Began 3 mos. before operation.	Hard, parametritic mass (cellulitis) in left side. Above this a large mass extending to umbilicus.	Laparotomy. Dense adhesions to left broad lig. separated. Only a little pus. Area drained by abdominal incision and by vagina.	Streptococci.	Peritonitis within 24 hours. Death 4th day.
2 [32]	Cause, sepsis from labor. Began 2 yrs. before operation.	Not recorded.	Laparotomy. Dense adhesions to left broad lig. Tube and ovary removed. No drainage.	Streptococci alone in both smear and culture.	Peritonitis. Cavity reopened and drained. Death 7th day.
3 [32]	Cause, sepsis from miscarriage. Began 1 mo. before operation.	Parametritic mass in left side, connecting with mass apparently involving tube and ovary.	Extraperitoneal operation above Poupart's lig. Two ounces of pus drained from broad lig. Tube and ovary not involved.	Streptococci alone, in both smear and culture.	Prompt recovery.
4 [32]	Cause, sepsis from labor. Began 1 mo. before operation.	Parametritic mass in both sides, connecting above with a mass extending as high as umbilicus.	Laparotomy. Pus found in both tubes, and three abscesses in left broad lig. Tubes, ovaries, and uterus removed. Free vag. drainage.	Streptococci alone, in both smear and culture.	Tedious recovery.
5 [33]	Cause, sepsis from miscarriage. Began 10 weeks before operation.	Not recorded.	Laparotomy. Findings not recorded.	Streptococci in culture only. None in smear.	Death.
6 [33]	Not recorded.	Not recorded.	Laparotomy.	Streptococci in culture only. None in smear.	Death.
7 [31]	No cause apparent. Not entirely well since last labor 19 yrs. before. No history of gonorrhœa. Severe symptoms began 2 yrs. before operation.	Not recorded.	Laparotomy. Abscess in cul-de-sac and involving adnexa. Tubes, ovaries, and uterus removed.	Streptococci mixed. No gonococci.	Prompt recovery.
8 [31]	Cause, severe sepsis from labor. Began 12 yrs. before operation.	Pelvis filled with parametritic mass of bony hardness, surrounding the uterus.	Vaginal incision and drainage. One ounce of pus escaped.	Streptococci in cultures. Smear not satisfactory	Slow improvement. Final recovery.
9 [31]	Cause, sepsis from miscarriage. Began 3 mos. before operation.	Parametritic mass dense, hard, filling pelvis to symphysis and extending along vagina.	Vaginal incision and drainage. Abscess in left broad ligament and extending to back of pelvis.	Streptococci in both smear and culture.	Slow recovery. Three tube drainage tract still open.
10 [31]	Cause, sepsis from labor. Began 2 mos. before operation.	Mass in right lower abdomen, extending as high as umbilicus. No definite statement as to parametrial involvement.	Vaginal puncture, but could not reach into mass. Extraperitoneal operation above Poupart's lig., but opened into peritoneal cavity. Laparotomy, extirpation of adnexia, and drainage by abdominal incision.	Streptococci in culture. None in smears.	Good recovery in six weeks. Wound healed from bottom.
11 [31]	Cause, sepsis from labor. Began 11 wks. before operation.	Not recorded.	Laparotomy. Exploration showed trouble was principally in left broad lig. Vaginal drainage not practicable. Extraperitoneal drainage above Poupart's lig.	Streptococci in both smear and cultures.	Good recovery in six weeks.
12 [31]	Cause, sepsis from labor. Began 6 wks. before operation.	Pelvis filled with dense, indurated mass, which extends into left broad ligament.	Vaginal drainage. No pus found. Indurated tissue was broken down by finger. Cul-de-sac opened.	Streptococci in both smear and cultures.	Stormy convalescence. Final recovery after antistreptococci serum.
13 [26]	Cause, severe sepsis from labor. Began 6 years before operation.	Mass in right broad lig. extending to sacrum and around rectum to left broad ligament so firm and so intimately attached to sacrum that it was formerly diagnosed as sarcoma of same. Mass extended up into abdomen.	Laparotomy. Dense adhesions. Mass found to be retroperitoneal. Abdominal wound closed and mass drained by vag. incision. Pus found in left broad ligament.	Streptococci.	Good recovery in three weeks.
14 [34]	Cause, sepsis from miscarriage. Began 2 mos. before operation.	Mass in lower abdomen and œdema of abdominal wall, evidently from parametritis anterior.	Incision into œdematous area and evacuation of pus from abscess.	Streptococci in both smear and culture.	Recovery.
15 [34]	Cause, sepsis from labor. Began 13 mos. before operation.	Hard rounded mass in tubo-ovarian region, extending into left broad ligament.	Laparotomy. Removal of left tubo-ovarian mass. Free vaginal drainage.	Streptococci.	Prompt recovery
16 [34]	Cause, sepsis from labor (premature). Began 5 wks. before operation.	Mass occupying right anterior part of pelvis apparently in connective tissue (parametrium).	Vaginal puncture, but not satisfactory. Then extraperitoneal operation above Poupart's lig. Several small pockets of pus.	No streptococci found, but exam. not satisfactory.	Slow recovery.

STREPTOCOCCIC TABLE (*Continued*)

Case and Ref. No.	Cause and Time of Onset	Examination	Operation and Findings	Convalescence	Bacteria
17 [35]	Cause, curettement. Exact time not stated but several years before operation.	Mass filling pelvis and extending into left broad ligament and down along vaginal wall.	Laparotomy. Pus in tubes. Mass in broad lig. but no pus there. Later vag. drainage of mass, but no pus found.	No exam.	Prompt recovery.
18 [35]	Cause, sepsis from labor. Began 5 mos. before operation.	Large mass in right lower abdomen, extending into right broad ligament.	Extraperitoneal operation above Poupart's ligament. Later a counter opening per vaginam was necessary.	No exam.	Slow recovery.
19 [36]	Cause, sepsis from labor. Began 6 mos. before operation.	Pelvic abscess (parametritic?) evacuated by vaginal incision 8 days after labor. Six months later still a pelvic mass back of uterus and attacks of peritonitis.	Vaginal incision into mass in cul-de-sac. No pus but serous fluid showing staphylococci only.	Streptococci at first. Six mos. later, only staphylococci.	Slow recovery.
20 [36]	Cause, sepsis from miscarriage. Began 16 mos. before operation.	Double pyosalpinx. No mention of parametrial involvement.	Laparotomy. Both tubes enlarged and filled with pus. Pus also pocketed in peritoneal cavity.	Streptococci in pure culture, in tubes, and in peritoneal abscess.	Recovery in six weeks.
21 [37]	Cause, sepsis from miscarriage. Began 3 mos. before operation.	Mass in left side of pelvis. Not clearly outlined. Diag. tubo-ovarian abscess.	Laparotomy. Tubes and ovaries normal. Left broad ligament distended by inflammatory mass. Abdom. incision closed. Abscess drained by vag. incision two weeks later.	No exam.	Recovery.
22 [12]	Cause, sepsis from miscarriage. Began 7 weeks before operation.	Mass in right tubo-ovarian region extending upward into appendix region and downward into upper part of broad ligament.	Laparotomy. Upper mass formed by adherent intestines and adnexa. Principal trouble in right broad ligament. Area drained through abdom. incision. Four weeks later, drained by vaginal incision.	Streptococci mixed.	Extensive suppuration of drainage tract and wall of abdom. Two weeks later, fæcal fistula. Slow recovery in two months.
23 [38]	Cause, sepsis from abortion. Began 4 mos. before operation.	Mass in right side, supposed pyosalpinx, accompanied by another mass the nature of which is not stated (parametritic?).	Laparotomy. Right pyosalpinx and another mass in side of pelvis (parametritic?).	Streptococci.	Death, 12th day, preceded by fever and abdominal symptoms.

fections concerning which definite information has accumulated as to persistence of virulence, are the gonococcal and the streptococcal.

In the gonococcal cases, the bacteria are dead or attenuated to practical sterility within three or four months from the beginning of the trouble. In such cases abdominal section may be safely undertaken after this period. In the streptococcal cases, on the other hand, the bacteria live and retain their virulence indefinitely. In some cases there seems to be a diminution in the virulence, but this is erratic and not to be depended upon. Abdominal section for a mass of streptococcus origin is never safe. Such an operation at any time, even years after the infection, is liable to be followed by fatal peritonitis.

4. These two classes may be distinguished before operation in most cases, the distinguishing characteristics of each being found in the *apparent cause* of the trouble and the *location* of the lesion, as already explained in detail.

5. "What is the preferable time for abdominal operation for a chronic inflammatory mass in the pelvis?"

a. In a case that is clearly gonococcic (agreement on the two points — the apparent cause of the trouble and the location of the lesion) abdominal operation may be considered safe after three or four months from the onset of the trouble. If after this time the mass is a source of serious irritation in spite of palliative treatment, it should as a rule, be removed. On the other hand, if there is marked improvement it is better to wait, as nature may bring about recovery without operation.

b. In a case that is clearly streptococcic (agreement on the two points) abdominal section is never safe. Even where the temperature and pulse are normal and everything

quiescent, intraperitoneal operation for the mass is liable to cause the patient's death from streptococcal peritonitis.

c. In a case that is doubtful (disagreement on the two points) a most careful study should be made of all the features of the case and every helpful diagnostic method should be brought into use to aid in reaching a positive conclusion. No intraperitoneal operation should be undertaken until the streptococcus is excluded with reasonable certainty. In a doubtful case in which the abdomen is opened on the supposition that the mass is tubo-ovarian and it is found, before adhesions are much disturbed, that the mass is principally in the connective tissue (parametritic) the route of attack should be changed to extraperitoneal (per vaginam or above Poupart's ligament) and the abdominal wound closed. Such a lesion probably contains streptococci and the adhesions of omentum and bowel, which caused the deceptive mass high in the tubal region, constitute nature's barrier between the virulent bacteria and the peritoneal cavity. When this barrier is broken down, the way is opened for a fatal peritonitis (see the table of streptococcic cases).

6. There are three reasons for calling attention to this subject: *a.* A matter of such vital importance should, I think, be given more prominence in text-books and in instruction to students and in society proceedings and discussions concerning pus collections in the pelvis. *b.* Lives are still being sacrificed by operators who seem unaware of the great danger of abdominal operation for inflammatory masses following puerperal sepsis. *c.* Further investigation (with careful recording in a large series of cases, of the apparent cause of the trouble, the location of the lesion, the interval of time from infection to operation, the bacteriologic findings, and the result of operation) is required that the definite classification of the cases before operation, as above indicated, may be firmly established and errors eliminated.

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THE EVOLUTION OF OVARIOTOMY IN FRANCE[6]

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IT is an honor to me as well as a pleasure to address you in reply to your kind invitation. No one appreciates better than I do the important services that American science has rendered surgery and gynecology. Of this, the present centenary is a striking proof, for McDowell's bold initiative represents more than the performance of an operation considered hitherto impossible; it stands out as a landmark to a new era, inasmuch as from that date the road was opened to all abdominal operations. The names of such enterprising surgeons should be engraved in the marble in all operating theatres: McDowell of Kentucky, Nathan Smith of New Haven, Connecticut, Alban Smith, L. Atlee, etc., thanks to whom ovariotomy became a current operation in your country at a time when, in Europe, it was specialized in the hands of a few men whose daring attempt was condemned as rush to excess.

In the following paper, I shall attempt to state, as briefly as possible, France's contribution to the history of ovariotomy. If you have the patience and endurance to listen to my poor English, it may perhaps appear to you that the part played is by no means a trifling one and that the names of some French surgeons can be inserted by the side of those who in America, in England, and in Germany (merely to mention these great countries) have successively perfected the technique and improved the results of that admirable operation.

I. THE PRECURSORS — THE FIRST FRENCH OPERATORS — WOYCIKOWSKI: VAULLEGEARD

I must say a few words of those who can be named the precursors in the eighteenth century. It seems that in France the idea of ovariotomy was first suggested towards the middle part of this century by Delaporte in 1755.[1]

Morand[2] in the same time approved the suggestion of Delaporte, Laumonier[3] (from Rouen) removed an ovary during an operation for iliac abscess in 1775. But it was not an intended and regulated operation.

Chambon de Montaux, speaking theoretically, said: "I am convinced that a time will come when this operation (removal of the ovaries) will be extended to cases more numerous than those in which we have proposed it and that no objection will be made to its performance."[4]

Thus at this remote period conception of the operation existed, but many years were to elapse ere it attained realization.

Nineteenth century. In the year 1807, in a thesis submitted by Dr. Escher to the faculty of medicine of Montpellier, a plan is described for ovariotomy. This paper discusses the steps in ligating the pedicle, but only on a theoretical point of view.

This was the time, when in the United States a great stride was made in 1809 in the first performance of ovariotomy by McDowell, of Kentucky, and later by Nathan Smith and Alban Smith. After the long series of operations by W. L. Atlee it can be said that ovariotomy was acclimated in America as early as the middle of the last century.

In France, great surgeons, such as Dupuytren, Boyer, Giraldès, Velpeau,[5] appalled at the dangers of an operation apparently so hazardous, absolutely refused to support it.

Meanwhile, far from Paris an ignored general practitioner, Dr. Woycikowski, at Quingez (Doubs), had performed with success for the

[1] "Hydroposve enk y stee de l'ovaire attaquée par l'incision." Mémoires de l'Académie Royale de Chirurgie. Nouvelle édition, 1837, tome iii, p. 341.

[2] Mémoires de l'Académie Royale de Chirurgie. Nouvelle édition, 1837. tome iii, p. 350.

[3] Cf. Gallez — Histoire des Kystes de l'Ovaire envisagée surtout au point de vue du Diagnostic et du Traitement. 1 vol. in 8° Bruxelles, 1873, Manceaux, editeur.

[4] Maladies des femmes: Maladie chronique à la cessation des regles: de l'extirpation des ovaires. 5e partie Chap. xxxix, p. 293.

[5] Dupuytren: Médecine opératoire de Sabatier, Edition de Dupuytren t. ii, p. 503, Boyer: Traité des maladies chirurgicales. Ch. xxxvi, p. 489. Paris 1849 — Giraldès: Rapport lu à la Société Médicale d'émulation sur la Thèse de Concours de Cazeaux (Kystes de l'ovaire, 1844 — Velpeau, Gazette des Hopitaux, 1847, p. 420.

[6] Read before the American Gynecological Society, April, 1909.

first time in France an intended ovariotomy on April 28, 1844.

A full description of the operation is given in a letter he then wrote to the "Journal de Médecine et de Chirurgie pratiques."[1]

The patient was a woman who called him to confine her, for she was thought to be pregnant. He found that she was suffering from ascitis and he tapped her. He was then able to perceive a movable tumor above the pelvic brim. The patient begged for its removal and Woycikowski decided to perform a laparotomy, which in those days was called *gastrotomy*.

The tumor was not a cystic, but a solid one, weighed 6½ pounds; it was smooth, knobby, and the Fallopian tube with its fimbriated extremity was adherent to it. It was probably an ovarian fibroma or sarcoma. The patient made a perfect recovery. Four months later, this woman became pregnant and at normal term she was delivered of a healthy boy. She was confined a second time in December, 1846, of another boy equally strong.

On September 15, 1847, once more far from Paris, at Condé-sur-Noireau (Calvados) a provincial doctor, Dr. Vaullegeard, performed another ovariotomy which was also successful.[2]

Moreover he pointed out the principal steps of the method to be followed: "Open the abdomen more or less widely, grasp the tumor, reduced or not in size by one or more punctures; then separate it after having tied the pedicle."

Despite those two successes, general opinion in France remained resolutely hostile to ovariotomy. In 1856 C. L. Bernard, after stating the results especially abroad, had pleaded in vain in its favor;[3] and the Academy of Medicine condemned it, in spite of Cazeaux's bold protest: "I am of the opinion," said he, "that before condemning a method we should carefully examine it, and this has not been sufficiently examined. If we reserve it for cases of multilocular and areolar cysts and for those where the fluid is albuminous and gelatinous, I have no hesitation in stating my conviction that the operation is fully advisable." We must remember that at this time in France, especially after Boinet's work, it was taught that unilocular and serous cysts could be cured by iodine injections.

Such was the state of things when, in 1860, M. Worms, a distinguished Paris general practitioner who had many medical friends in England and who followed closely surgical progress in that country (although not a surgeon himself) attempted to draw again attention to ovariotomy in an important paper entitled: Etude Historique et critique sur l'Extirpation des tumeurs kystiques de l'ovaire.[4]

This paper and another of Boinet[5] on the same subject seem to have had a decided influence. In November, 1861, Professor Nelaton decided to go to England to see Baker-Brown operate. On his return he delivered a sensational lesson in the *Hopital des Cliniques*, on ovariotomy. Then for the first time the justifiability and legitimacy of this operation were proclaimed by a professor in a French University.

On February 2, 1862, in the presence of Nelaton and Trousseau, Demarquay, surgeon to the *Maison Municipale de Santé*, operated at Saint Germain a young girl of nineteen whom he had removed from the unhealthy surroundings of the hospitals in Paris. She had an ovarian cyst weighing about forty pounds. Unfortunately she died from peritonitis in three days. Pasteur and Lister had not yet appeared; but new times were coming.

On June 2, 1862, my illustrious countryman, Koeberlé[6] at Strasburg (then a French city) removed the first ovarian cyst and successfully began the series of brilliant operations which placed him in the front rank of French ovariotomists. On September 29th he was again successful and again on December 4th and 20th of the same year. Koeberlé already anticipated asepsis by cleanliness.

In Paris results were less favorable, and mortality was very heavy. At the end of 1862 out of 13 operations there were but 7 recoveries against 6 deaths (5 in Paris and 1 in Lille). Nevertheless, the impulse was given; Nelaton, Koeberlé, Boinet, Péan, took the lead. The

[1] 1847, t. xviii., pp. 145–148.

[2] Journal des Connaissances médico-chirurgicales. Juin, 1848, p. 224.

[3] Archives générales de Médicine, 5e série, t. viii, p. 462, 1856.

[4] Gazette Hebdomadiare, Octobre, 1860, p. 462.

[5] Gazette Hebdomadiare de Médecine et de Chirurgie, 1860, Nos. 1, 5, 7, 16.

[6] Koeberlé: De l'ovariotomie (Mem. de l'Acad. de Méd. de Paris, 1863, t. xxvi, p. 321 à 472, avec 6 pl. lithographiques).

number of operations increased so that in 1867 more than 122 operations were performed in France; the percentage of recoveries was still very low (49 out of 122). But two factors were soon going to cause a decrease in the mortality; an improved technique, and, more important still, the introduction of antisepsis first, of asepsis later on.

II. THE PROMOTERS OF OVARIOTOMY — KOEBERLÉ — PÉAN

The two men who have done the most for settling the steps of the operation and immensely improving the technique are Koeberlé of Strasburg and Péan of Paris. We shall consider successively: A. Their technique; B. Their results.

A. Technique. The points of technique which most preoccupied operators at this time were (*a*) Hæmostasis; (*b*) treatment of the pedicle; (*c*) suture of the abdominal walls.

(*a*) *Hæmostasis. The first hæmostatic forceps.* An important point in the technique and one which was fully understood by Koeberlé and Péan (whose work on the subject was almost simultaneous) was rapid hæmostatic, allowing an operation already too lengthy, to be shortened. Hence came the forcipressure or substitution of forceps for immediate ligature. Much time was thus avoided.

This was an unusual improvement of which the benefit was extended later to all surgical operations. It must not be forgotten that this technique, which made a kind of revolution in the performance of hæmostasis, is unquestionably a French one. All the forceps of Thornton, Kocher, etc., come from the original forceps of Koeberlé and Péan, but the question of priority between the latter is very difficult to resolve.

Koeberlé [1] got Elser, a surgical instrument maker in Strasburg, to make for him in 1865 a forceps somewhat analogous to Charriere's old dressing forceps, provided with a rack fastening (*goupille*) which allowed one to grasp and compress to some extent tissues of various thickness. He first mentions the use of

[1] Koeberlé: De l'hémostase définitive par compression excessive (Paris, 1877) — Bulletin et Mém. de la Soc. de Chirurgie de Paris, 1876, p. 767. Epilogue (Paris, 1877) — L'hémostase definitive rapide par les pinces hémostatiques et la suppression de la ligature ont été inventées à Strasburg en 1867 (Strasburg, 1893) — Gross: Les pinces hémostatiques des docteurs Koeberlé et Péan et la forcipressure (Revue médicale de l'Est, 1876, t. v, pp. 182–190). Koeberlé: Gazette des Hopitaux, 1868, p. 419.

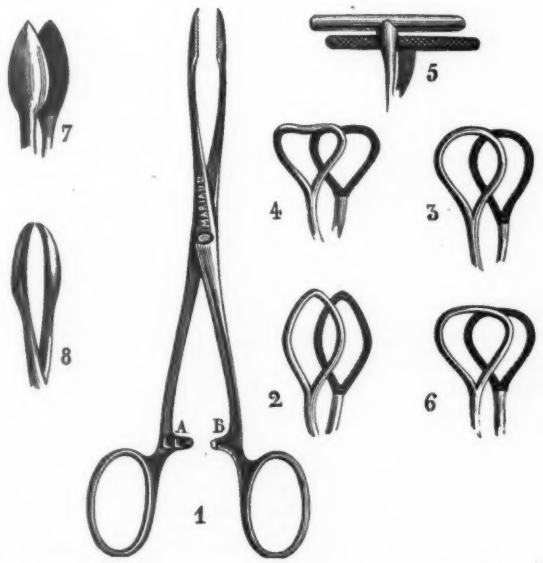

Fig. 1. Different kind of Péan's hemostatic forceps. 1, Ordinary hemostatic forceps opened; 2, Diamond shape 3, Ring-like; 4, Triangle shape; 5, T shaped; 6, Heart shape; 7, Ordinary flat; 8, Curved.

these hæmostatic forceps in a paper published in Strasburg in 1866[1] and since 1868 he generally used them for rapid hæmostasis, and rarely used at once ligatures. Dr. Revillout[2] in 1868 made known in Paris the new method of securing hæmorrhage which he had seen adopted by the Strasburg surgeon.

Péan[3] had, like Koeberlé, begun by making use of Sédillot's "serres-fines."[4] In 1868 he got Guéride[5] to make some hæmostatic forceps

Fig. 2. Koeberlé's hemostatic forceps.

of varied shape, which appeared from that date in the catalogue of that instrument maker. The main point in the discussion of priority and one which does not seem easy to be decided is whether Koeberlé's assertion is correct, that the forceps he was daily employing was adopted by Péan, more or less perfected, after the publication of Revillout, or whether Péan's is the correct assertion, viz., that he was the inventor of the instrument when operating at Paris under the same necessity as Koeberlé at Strasburg. All the same, whether he invented it first or at the same time, Péan, owing to his high position in the Paris hospitals and to his large practice, helped most considerably to make the use of the hæmostatic forceps general and his name with that of Koeberlé must remain attached to the method.

Professor Verneuil[6] in a subsequent paper where he has sketched with a learned hand the history and indications of vessel-clamping, has done much for the extension and proper use of this method which, originating in Strasburg and Paris, has long since made its way in the world.

(*b*) *Treatment of the pedicle: clamps; serre-noeuds; ligatures.* The treatment of the pedicle could be accomplished by two methods: the extraperitoneal method and the intraperitoneal or sinking of the pedicle in the abdominal cavity.

At first, for Koeberlé as well as for Péan there could be no question of anything but an extraperitoneal treatment of the pedicle. It was thought that this method allowed of more perfect hæmostasis and moreover, surgeons were afraid of leaving inside the peritoneal cavity a ligated part liable to undergo mortification. Hæmostasis of the pedicle was at that time secured by means of a clamp modified from the first Hutchinson's clamp. Koeberlé[7] devised a pattern of clamp (Koeberlé's clamp or constrictor).

Later on, French surgeons adopted the almost exclusive use either of the écraseur à corde métallique or écraseur de Guéride or of métallic serre-noeuds. (The earliest of these was Koeberlé.)

With this instrument the metallic loop which embraced the pedicle could be tightened gradually and strongly by means of a screw. A metallic brooch, transfixing the pedicle, prevented the wire from slipping; a silk ligature secured the whole. Koeberlé's serre-noeuds the length of which was of 8, 11, or 14 centi-

[1] Opération césarienne pratiquée avec succès dans un cas de grossesse dans un uterus bicorne, 21 mois aprés la mort du fœtus au 7e mois (Strasburg, 1866).

[2] Gazette des Hopitaux (1868, No. 75, p. 297).

[3] Péan: Du pincement des vaisseaux comme moyen d'hémostase (Leçons extraites du tome II des cliniques chirurgicales. Paris, 1877.) Deny et Exchaquet: De la forcipressure ou de l'application des pinces à hémostase chirurgicale, Paris, 1875. Péan Comptes rendus, memoires et discussions du premier Congrès français de Chirurgie, 1866, p. 388. Verneuil et Péan: Discussion (Bulletin Medical, 1893, pp. 659, 985 et 997).

[4] Ovariotomie et splénotomie (Paris, 1869, p. 51).

[5] This is now the "Maison Mariaud."

[6] Bulletin et Mem. de la Soc. de Chirurgie de Paris (1875), pp. 17, 108, etc.

[7] Koeberlé: Art Ovaire-Ovariotomie, in Dict. de Médicine et de chirurgie pratiques. Paris, 1878, p. 583.

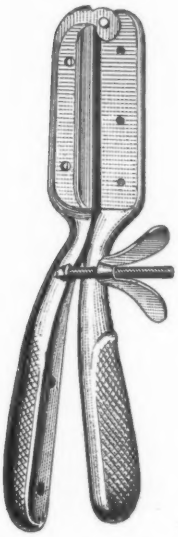

Fig. 3. Hutchinson's clamp.

meters, enabled the operator to tie even deep pedicles. Dr. Cintrat introduced a good modification of this instrument: it consisted

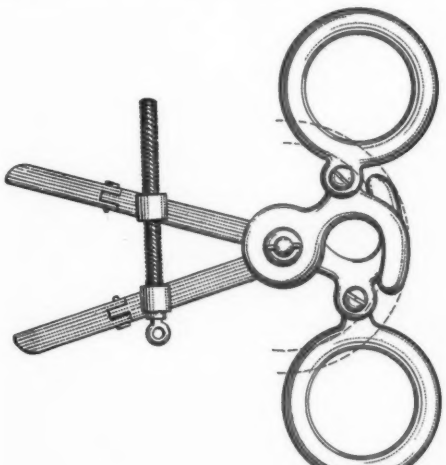

Fig. 4. Koeberlé's clamp.

in the rendering movable the piece for the twisting of both ends of the thread. This improved instrument was adopted by Péan.

The advantage of the serre-noeud, was that by its use extreme constriction of the pedicle was effected: hence came a reduction of its size and secure hæmostasis. Koeberlé used to remove the serre-noeud from the fifth to the eighth day. Notwithstanding, Koeberlé afar (1878) foresaw the time when the triumph would be for the sinking of the pedicle.[1]

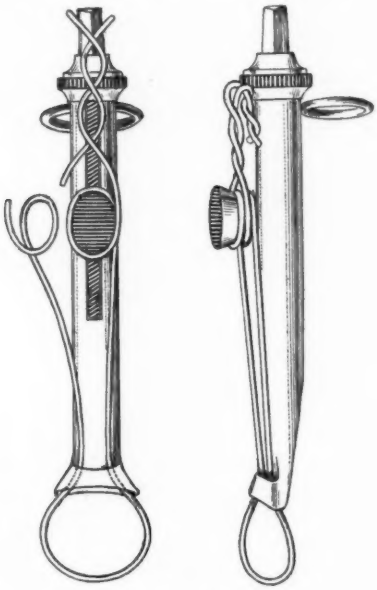

Fig. 5. Ecraseur de Guéride.

Péan used generally extraperitoneal treatment of the pedicle. He had imagined different models of clamps; some for the purpose of clamping the tissues so tightly that they became like parchment before cauterizing them; others were intended merely to act like a temporary ligature.

(*c*) *Sutures of the abdominal walls.* Koeberlé used to pass a threaded needle at a variable distance from the edges of the wound according to the thickness of the tissues to be traversed. Passing on to the other side the needle then followed a similar course, traveling in the direction through the subperitoneal cellular tissue, the fasciæ, the muscles and

[1] Koeberlé: Art Ovaire-Ovariotomie, in Nouveau Dict. de Médicine et de chirurgie pratiques. Paris, 1878, p. 583.

Fig. 6.

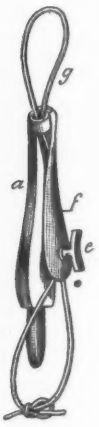

Fig. 7.

Fig. 6. Koeberlé's Serre-noeuds.
Fig. 7. Dr. Cintrat's modification of Koeberlé's Serre-noeuds, used by Péan.

finally the skin. The needle carried two silk threads; these were tied, on each side of the wound around a piece of gum catheter; three or four of these stitches were generally required. The edges of the wound were united in their entire length by this bilateral pressure. The peritoneum was never involved in this suture.

The deep sutures of Koeberlé were generally three in number; placed at 4, 7, and 10 centimeters from the edges of the wound and passed through the abdominal fasciæ at two centimeters at least from the edges. Five or six stitches of superficial sutures with pins and twisted thread united the skin.

Péan used to employ a more expeditious method of suturing. The wound was closed entirely — except at its lowest part occupied by the pedicle — by means of separate loops of wire. These stitches, passing through the walls at a great distance from the edges of the wound, involved the peritoneum. In the intervals between them, the skin was united with pins and twisted thread.

Koeberlé, who observed great precautions of strict cleanliness, used to aspirate the fluids which collected in the dependent parts of the wound on the days following the operation. He did not practice drainage. He was very cautious in protecting the bowels during the operation, by means of small towels. Koeberlé was very skillful in using these towels to loose adhesions by friction, according to a technique which since became general.[1]

Scrupulous care and strict isolation of his patients were powerful factors in the prevention of infection.

I must recall certain other points in the technique of ovariotomy to which Péan drew attention:[2] lost metallic ligatures; occasional drainage of the pedicle through the abdomen or through the vagina and use in this case, of a special trocar for the purpose of passing this abdomino-vaginal tube, and a number of special instruments for ovariotomy (forceps, aspiration-trocar, etc.).

Like Koeberlé, Péan recognized the necessity for extreme cleanliness in operating, though

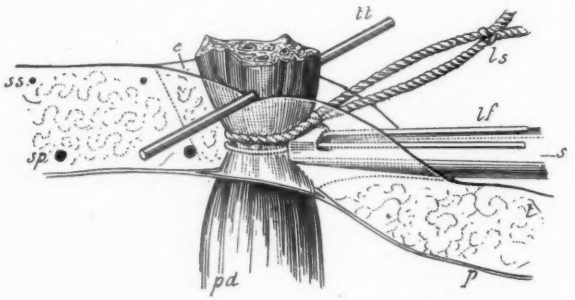

Fig. 8. Péan's method of treating the pedicle. lf, Serre-noeud, ll, Broche, pd, Pedicle, p, Peritoneum.

[1] Auguste Reverdin. Souvenirs Gynécologiques. Revue de Gynécologie, 1906, p. 419.
[2] Exposé des titres à l'appui de la candidature du Dr. Péan à l'Academie de Médecine, 1880.

the antiseptic era had not yet arrived. He washed his hands carefully, and as much as possible only touched the wounds with instruments. By a strange anomaly, he took a certain pride (except towards the end of his life)

Fig. 9. Péan's pin for closing the abdomen.

in not wearing an operating jacket or special covering when operating in public in the amphitheatre. He was always in evening dress, and hardly put on an apron or pulled up his cuffs. As a result his public operations had a

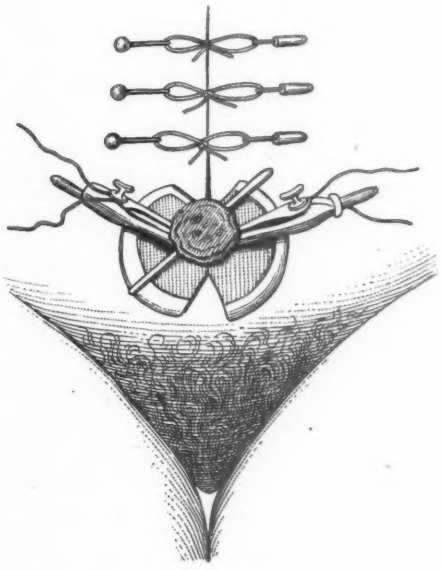

Fig. 10. Péan's method of treating the pedicle.

somewhat theatrical aspect which struck all visitors. However, in cases of laparotomy, Péan would abandon his somewhat solemn habits.

On such occasions he operated before few spectators. He then took off his dress-coat and put on a large oil-cloth apron, turning up his sleeves above the elbow, and operating with bare arms, which was quite exceptional for him.

B. The results. The following were the results of Koeberlé in 1878:[1]

In his first series of 100 cases there were 29 deaths (of which 5 were of double ovariotomy).

In his second series of 100 cases, 32 deaths.

In his third series of 93 cases, 14 deaths; thus giving a total mortality of 25 per cent. (18 per cent only for the last 150 cases).

In opposition to Koeberlé's statistics Péan exhibited a percentage of successes surpassing those of the Strasburg surgeon. Koeberlé had performed his first ovariotomy in 1862; Péan performed his in November, 1864. His patient was cured and, with two others she was presented to the Academy of Medicine in 1865. In 1867 he read before the Academy of Sciences[2] a report on five cases of ovariotomy, four of which were cured. In 1869 he had performed 13 ovariotomies with three deaths. To permit comparison with Koeberlé's statistics we here quote Péan's results as tabulated by him in his "cliniques."

First series, November 1, 1864, to December 31, 1875: 180 ovariotomies; 44 deaths; 136 recoveries. Mortality, 24.4 per cent.

Second series, January 1, 1876, to December 31, 1877: 55 ovariotomies; 40 recoveries; 15 deaths. Mortality, 27.2 per cent.

Third series, January 1, 1878, to July 1, 1881: 116 ovariotomies; 97 recoveries; 19 deaths. Mortality, 16.3 per cent.

Fourth series, July 1, 1881, to December 21, 1884: 131 ovariotomies; 119 recoveries; 12 deaths. Mortality, 9.9 per cent.

Fifth series, January 5 to December 16, 1885: 46 ovariotomies; 45 recoveries; 1 death. Mortality, 2.1 per cent.

Sixth series, January 1 to December 31, 1886: 64 ovariotomies; 62 recoveries; 2 deaths. Mortality, 3.1 per cent.

Seventh series, January 1 to December 31, 1887: 46 ovariotomies; 46 recoveries; no deaths. Mortality, 0 per cent.

His entire statistics from 1864 to January 1, 1894, comprise 2,596 laparotomies[3] and his last ovariotomy statistics are as follows:

One hundred and twenty-four cases; 103

[1] Nouveau Dictionnaire de Médecine et de Chirurgie pratiques, 1878. Art. Ovaire, tome xxv, p. 586.

[2] Péan: L'ovariotomie peut-elle etre faite à Paris avec des chances favorables de succés? Observations pour servir à la solution de cette question présentées à l'Academie des Sciences le 7 Janvier, 1867.

[3] Cliniques chirurgicales de l'Hopital St. Louis" published in 1899.

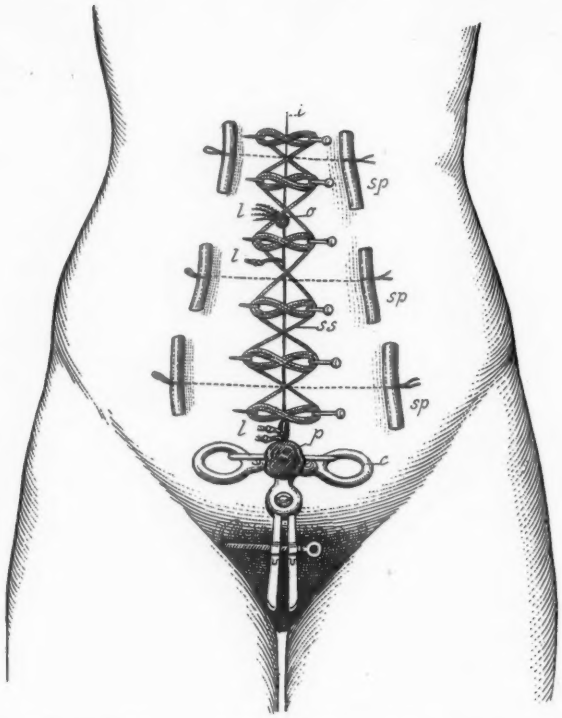

Fig. 11. Péan's method of closing the abdominal wall and treatment of the pedicle. c, Clamp; p, Pedicle; sp, Wire loops; ss, Twisted thread around the pins.

recoveries; 4 deaths by the abdominal route; 17 recoveries in 17 operations by the vaginal route.

In the course of this long period Péan had gradually improved his technique. After having for a long time made use of the external pedicle method combined with the use of Cintrat's serre-noeud, he later on adopted the intraperitoneal method, especially with the use of antisepsis.

III. CONTEMPORARY PERIOD. TERRIER, HIS FELLOWS, AND HIS SCHOOL

The work of Terrier. Péan and Koeberlé were in France the first great specialized ovariotomists. There came one man, later, who, by observing thoroughly in ovariotomy not only scrupulous cleanliness but also the stringent rules of antisepsis and of asepsis, has caused abdominal surgery to take in France a definite stride in the direction of increased security. This leading man is Terrier, and we can say that every modern French surgeon is more or less consciously his pupil, and is indebted to his memory.

Terrier began his practice of ovariotomy by a success on July 15, 1877. In his very first operations he contented himself with being extremely clean as regards his instruments, his sponges, his hands, and those of his assistants and used no antiseptics. This method he applied in his first eleven operations and it gave him nine recoveries and only two deaths. The following six operations were performed according to the rules of Listerism (from April 24, 1878) without the use of the spray, however. The six operations were successful. Henceforth (from March 29, 1879) he applied the Listerian principles in their integrity, including the spray, until much later, when he evolved the first principles of asepsis.

In the beginning Terrier carried out the external treatment of the pedicle, like Koeberlé and Péan.

For the first time he left the pedicle in the abdominal cavity at an operation he performed with myself on September 26, 1878.[1] This operation appears as the sixteenth case in his first statistics; it was not an ovarian cyst, but a papillomatous tumor; cauliflower-like, of both ovaries.[2] Both pedicles were tied with catgut (which I was already using exclusively); they were so short that it was impossible to draw the pedicle outwards and they had to be left in. The patient recovered, and lived twenty years more.

Terrier again used the method of the sunken pedicle,— this time purposely — on March 29, 1879. The ovarian pedicle was tied with carbolized silk. Henceforth he applied this method more and more frequently. From 1880 this was his habitual technique. I adopted it in the same time and so did most surgeons in Paris.

Terrier[3] has published the results of his first 200 ovariotomies in eight series of twenty-five each.

The following are his results: First series, July 15, 1874, to May 14, 1880; 25 ovariotomies; 3 deaths.

Second series, May 20, 1880, to July 1, 1882; 25 ovariotomies, 9 deaths.

Third series, July 24, 1882, to January 29, 1884; 25 ovariotomies, 2 deaths.

Fourth series, February 5, 1884, to January 21, 1885; 25 ovariotomies, 5 deaths.

Fifth series, January 24, 1885, to December 15, 1885; 25 ovariotomies, 6 deaths.

Sixth series, December 22, 1885, to November 30, 1886; 25 ovariotomies, 4 deaths.

Seventh series, December 7, 1886, to February 14, 1888; 25 ovariotomies, 5 deaths.

Eighth series, March 6, 1888, to July 9, 1889; 25 ovariotomies, 3 deaths.

I shall confine myself to the above statistical quotations. It is impossible for me to review the statistics of all the French ovariotomists: Polaillon, Perier, Terrillon, Bouilly, Championnière, Richelot, Segond, etc.

IV. MODERN IMPROVEMENTS IN THE TECHNIQUE

A. Sutures of the abdominal wall in layers (en étages). One of the most important points is a good union of abdominal walls.

Towards 1886 most French laparotomists sutured *en masse*, in one single layer, using silver wire or silkworm. A few superficial stitches were put in to ensure approximation of the edges of the skin wound.

I introduced in 1886 a new technique;[4] that of suturing en étages in successive layers, which ensured against the chances of post-operative ventral hernia.[5] For the deeper layers I used catgut imbibed with oleum *ligni juniperi* which gave me very good results until the day when aseptic catgut became a possibility.

Championnirèe, Terrier, etc., then used Lister's carbolized catgut, but only as ligatures for vessels, not for uniting sutures.

I recommended later on, in 1894[6] intradermic suture of the skin in order to render the scar invisible. This I only use now in exceptional circumstances on account of the loss of time.

My present technique, slightly modified, of abdominal suture after laparotomy is as follows:[7]

The two edges of the peritoneal incision being well demonstrated with forceps I unite them by means of a continued suture of catgut, N° O.

The sheaths of the recti muscles (which should always be opened) are then united by a continued suture with catgut N° 1. Thus is sutured sound layer.

I unite the edges of the skin incision by means of another continued suture with catgut N° O. But before closing the skin, I place

[1] Terrier: Remarques cliniques sur une première série de 25 ovariotomies. Revue de Chirurgie, 1882, p. 349. Cf. the table, p. 368.

[2] Cf. Pozzi: Quatre opérations d'ovariotomie suivies de guérison (Gaz. med. de Paris, 1879, p. 96–98, 130–133, 161–164.

[3] Terrier: Remarques cliniques . . . . ae s.rie de 25 ovariotomies (Revue de Chir., 1884, t. iv, p. 1), 3e série (id. 1885, v, p. 13), 4e série (id., 1886, vi, p. 169), 5e série (id. 1887, vii, p. 677), 6e série (id. 1888, viii, p. 964), 7e série (id. 1889, ix, p. 605), 8e série (id. 1891, xi, p. 533).

[4] Pozzi: Pyosalpingite double avec ovarite suppurée gauche Salpingo orphorectomie double sans drainage consécutif. Guérison (Bull. et Med. Soc. de Chir., 1887, p. 574–578). La suture perdue continue à étages superposés au catgut. Son emploi en gynécologie (iiie Congrès français de Chirurgie, 1888, p. 515).

[5] I insisted too in the advantages of a short incision (non-complicated cases) from the double standpoint of asepsis and of the ultimate solidity of the abdominal opening.

[6] Pozzi: Sur un nouveau mode de suture de la peau (suture intra dermique) Bull. et Med. Soc. de Chir. de Paris, 1894, p. 145.

[7] Cf. Pozzi: Traite de Gynecologie clinique et opératoire, ive édition, tome 1, p. 104.

a single supporting *suture enchevilleé* with a double silver wire, the ends of which are twisted over little rolls of aseptic gauze.

Adipose tissue is thus united without any gap or dead space.

B. Pads (compresses) substituted to sponges. I also attempted very early to simplify the materials used for operation and to do away with harmful products. Experiencing great difficulties in getting sponges affording full guaranty of cleanliness, I gave them up since 1886, and then used and recommended pieces of gauze folded in squares (compresses), now used everywhere.

In the beginning to ensure their sterilization I had them cooked [1] for two hours in a weak carbolic solution at 1 per 1,000. A little later (1890) I sterilized my compresses with an autoclave and used asepsis instead of antiseptics.

C. Suppression of antiseptics in the cleansing of the peritoneum. About the same time (1888) I attempted to show that some of the antiseptic principles could be done away with, if the operator took care to be in the highest degree aseptic. Thus for the flushing of the peritoneum (*lavage du péritoine*) which was much more frequent twenty years ago than it is now, I recommended solutions of sterilized hot water with addition of salt at 6 per 1,000 instead of the antiseptic *lavage* used by all other surgeons in France.[2]

At that very time (January 7, 1888) I wrote on sterilization: "It would be still more desirable certainly to bring the compresses of gauze to a temperature of 120° centigrade in an autoclave so as to destroy germs and spores together. But an autoclave is not in the possession of everyone. So, sterilization by means of boiling water though not theoretically perfect, can render sufficient service in practice."

As early as 1890, I purchased one of Schimelbuch's autoclaves for my wards at the Broca hospital. It was one of the first, if not the very first, used in the Paris hospitals.

D. The triumph of asepsis. Finally, to-day, thanks to the efforts of Terrier, of his colleagues, and of his pupils, the triumph of asepsis is complete. Instruments, gauze, water, and salt solution are all purified by heat (autoclave at 133° centigrade or dry oven at 146° C.). The pedicles are ligated with catgut and their surface is carefully cauterized with the Paquelin's or covered with peritoneum; peritonization and drainage in severe cases prevent infection. The improvement of asepsis, the use of gloves, of protecting masks, etc., as well as the increasing skill of young surgeons in abdominal surgery have given in France, similar results as those obtained in other countries. So, nowadays ovariotomy is no longer an American but a universal operation.

[1] Pozzi: De l'antisepsie en gynécologie. Leçon du cours libre de Gynécologie professé à la Faculté de Médecine de Paris (semestre d'hiver, 1887–1888) Progrés Médical, 1888, 2e série, t. vii, p. 1 et 44, cf. also Bull. Soc. Chir. t. xiii, p. 576.

[2] Do — do — p. 44.

ŒSOPHAGOSCOPY AND GASTROSCOPY IN DIAGNOSIS[1]

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SINCE 1806, when Bozzini (1) first examined the upper end of the œsophagus, until 1906, when Chevalier Jackson(2) devised and perfected his œsophagoscope and gastroscope, untold earnest efforts by the most able and scientific men in the profession have been exerted to render endoscopy of the œsophagus and stomach of practical value in the diagnosis of disease of these organs.

It is singular, but nevertheless true, that the principle of the cystoscope influenced to such an extent that it early handicapped and retarded the construction of an instrument which was to prove itself the most useful model for purposes of gastroscopy. It was the attempt to adapt the methods of cystoscopy to examination of the stomach that resulted in the failures of von Mikulicz (3), Rosenheim (4), and Rewidzoff (5). By his instruments, Jackson (2), in addition to emphasizing the necessity for the employment of rigid tubes without angulation, has demonstrated the futility of a lens and prism system, pointing out the advantages of a simple hollow tube carrying the source of light on its distal end, enabling it to be passed without danger, by direct vision, often in the presence of aneurisms, neoplasms, and varices of the œsophagus. Furthermore, that the stomach, differing from the bladder in essential anatomical characteristics, should be examined preferably in a collapsed state, and, finally, that general anæsthesia is indispensable to insure quietude of the stomach during examination and to relax the diaphragm, thereby allowing a greater amplitude of motion of the hiatus diaphragmatis, through which the lower end of the tube passes, consequently increasing the explorable area.

Until very recently, diagnosis of œsophageal and gastric lesions, particularly the former, was largely inferential from the history and vague clinical symptoms, with the assistance of bismuth emulsions, X-rays, and bougies. The sheet anchor in the diagnostical armamentarium of the vast majority of practitioners was, and I regret to say is, the bougie. For not a few affections of the œsophagus, the passage of this instrument for purposes of diagnosis and treatment, is attended and followed by the most deleterious consequences.

It is not surprising, then, to note the heroic efforts made during the past century to perfect an œsophagoscope and gastroscope and to establish the practical utility of endoscopic examination for purposes of diagnosis by direct inspection and also by the removal of tissue for microscopical study. With the advent of the Jackson scopes, we possess instruments whose sphere of usefulness is not limited to the field of diagnosis alone, but which play a prominent part in treatment as well; namely, in facilitating applications to ulcers, in the removal of papillomata and polypi, and in the extraction of foreign bodies. *Certainly the day of the "coin catcher" and "horsehair probang" should pass into oblivion as having no place in modern surgery of the upper alimentary tract.* Finally, owing to the inability of the internist to make a differential diagnosis in many cases of gastric lesions, notably chronic gastritis, cancer, and ulcer, until the patient, in the case of carcinoma, has passed the possibility of cure by the surgeon, may it not devolve upon endoscopy with the perfection of the modern gastroscope to facilitate an early and urgent diagnosis?

Œsophagoscopy can be readily and usually satisfactorily performed under local anæsthesia, with the patient in either the sitting or supine position. The difficulties of œsophagoscopy attending the employment of Kirstein's (6) headlamp and tube and the type of instrument used by von Mikulicz and Rosenheim sink into insignificance in comparison with the Jackson œsophagoscope. This scope presenting an oval in cross section, is well adapted to the greater transverse diameter of the œsophagus. Little difficulty will be en-

[1] Read before the Philadelphia Academy of Surgery, April 5, 1909.

countered in the introduction of the tube to or into the stomach, if the operator will bear in mind a few facts relative to the anatomy of the œsophagus. The larynx, pharynx, and especially the pyriform fossæ, should be carefully inspected by the use of the electric oral speculum prior to the passage of an instrument, in order to ascertain the normal or any abnormal condition. The obstruction offered by the cricoid cartilage, frequently being held rigid posteriorly by the soft tissues, just below the introitus œsophagi, is readily surmounted by seeing that the head of the patient is not *over*-extended. Incidentally, it may be remarked that the proper holding of the head for this work is a most important act upon which success or failure commonly depends. Furthermore, it must be observed that the axis of the œsophagus as it passes through the diaphragm, is oblique from the right posteriorly to the left anteriorly, and that the œsophagus, below the hiatus diaphragmatis, deviates to the left. Limitation of time and space in this article forbids even an allusion to the finer points of anatomy and technique, a thorough familiarization with which is indispensable to the attainment of best results.

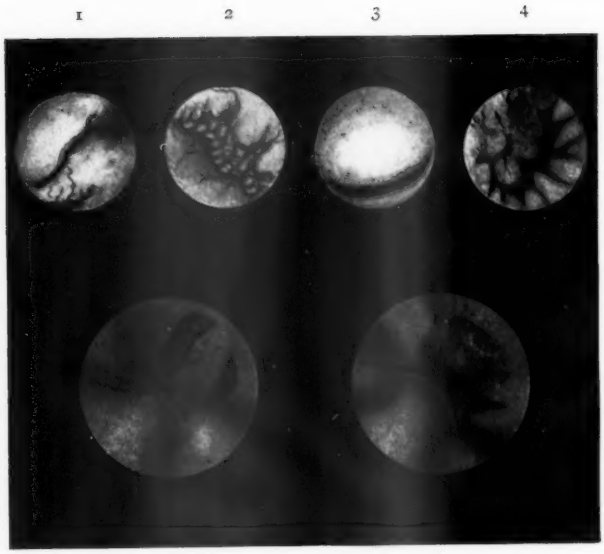
The dangers incident to the introduction of an instrument by direct vision under cocaine anæsthesia are very naturally *nil*. Hence, œsophagoscopy, when patiently and cautiously performed, is a very simple and feasible operation, and should be used more routinely for the information yielded.

Gastroscopy, although in the average case easily performed under general anæsthesia, is attended occasionally by difficulties, dangers, and contraindications which are insurmountable. For instance, stenosis of the œsophagus, on account of disease or spinal caries with kyphosis or lordosis, may render the introduction of a tube impossible. The danger arising from the removal of a small section of tissue for microscopical diagnosis is trivial and out of all proportion to the benefit which may accrue. The other dangers are simply those referable to ether or chloroform narcosis, which, in the presence of organic disease of the heart, lungs, and kidneys, constitute real contraindications, especially when associated with profound anæmia or cachexia.

The explorable area of the stomach varies from a third to practically the entire mucosa. It depends upon the relaxation of the diaphragm in general anæsthesia, thereby permitting a greater range of mobility of the hiatus diaphragmatis, and the ratio of the vertical to the horizontal axis of the stomach, being more explorable in the collapsed, contracted, and infantile forms and in gastroptosis because it is then nearer the median line. It can be further increased by movements of the head and neck laterally and anteroposteriorly.

A mere glance at the diseases prevalent in the upper alimentary tract will demonstrate the large sphere of utility for the modern œsophagoscope and gastroscope. If by œsophagogastroscopy we are enabled to make a differential diagnosis between such conditions as (1) malformation, (2) trauma, and the origin of hæmatemesis, (3) foreign bodies, (4) stricture and stenosis, (5) dilatation and diverticulum of the œsophagus, (6) ectasia and ptosis of the stomach, (7) acute and chronic inflammations, (8) peptic, syphilitic, tuberculous and actinomycotic ulcers, (9) abscess, (10) fistula, (11) benign and malignant neoplasmata, and (12) neuroses (including œsophagospasm, cardiospasm and pylorospasm), we have the greatest asset in one of the darkest and most undeveloped fields of surgery.

Mosher (7) states that in 88 out of 106 cases of stricture of the œsophagus, at the Massachusetts General Hospital, the nature of the stenotic process was undetermined. An analysis of the cases of œsophageal disease admitted to the surgical wards of the University Hospital since 1900, records the diagnosis of "stricture of œsophagus" in 57 per cent. For purposes of diagnosis and treatment in *supposedly* benign cases, the bougie was routinely used. In the majority of instances it has been impossible to trace the patient after discharge from the hospital, but in 50 per cent death resulted subsequent to admission, from œsophageal cause, mostly carcinoma. Therefore, with the common tripod of conditions, as symptoms of stricture, bougied, and death as early as a month after discharge, have we not a sufficient testimonial for more accurate methods of diagnosis? The statistics also demonstrate that 75 per cent of the cases of



Illustrating findings in Cases 1, 2, 3, and 4.

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stomach disease suffered from carcinoma, ulcer, and gastritis. A differential diagnosis, therefore, between these conditions, especially early in the course of the disease, is the most notable effort of the modern gastrologist. I believe this, at times perplexing, problem is nearer solution to-day by recourse to the straight, hollow-tube gastroscope than it has ever been. Its field of usefulness in not limited to a diagnosis of the various diseases of the stomach *per se*, but in the removal of foreign bodies, etc., it plays an important rôle.

On account of the increasing interest at present in œsophagoscopy and gastroscopy I desire to present the following four cases from the service of Dr. Charles H. Frazier, to whom I am gratefully indebted for the privilege of their report:

CASE 1. H. L. R., age 20, was admitted the first time to the University Hospital on January 13, 1905, complaining of inability to swallow solid food and of regurgitation of even liquid food at times. He stated that five years previously, while eating "fried rabbit a large piece stuck in his throat for a moment and was then swallowed." The difficulty in deglutition grew steadily worse and for several months prior to admission he had been under the care of Dr. Henry D. Jump, who had repeatedly passed bougies one-half to three-quarters of an inch in diameter, but without permanent relief. Under physic treatment, improvement was gradual but slight. He was discharged improved several times, only to be re-admitted. During his last admission, in December, 1908, he was submitted to an examination by the Jackson œsophagoscope.

Œsophagoscopy. Under cocaine pharyngeal anæsthesia, with the patient in the sitting posture, the tube was passed 16.8 cm. from the upper incisor teeth, when its progress was arrested by a stricture, depicted in Fig. 1. Although the mucous membrane was for the most part normal and musculature of the œsophagus apparently in a condition of tonic spasm, there were a few organic changes, as dilated, tortuous blood-vessels, a small area showed recent bleeding, probably the result of the passage of bougies the day before, and cicatricial blanching of the mucosa. After considerable patience, perseverance, and cocaine, during which time the muscularis tired, the end of the instrument all the time following the axis of the lumen, it was suddenly released and passed freely to the stomach through normal mucosa. The extent of the constriction was 2 cm. An interpretation of these findings would be that there existed primarily an œsphagospasm, incited by trauma, superimposed to which, by long continued bougie treatment, certain slight organic changes had occurred in the mucosa.

CASE 2. G. H. Y., age 54, was admitted to the University Hospital on June 24, 1908. Five months previous he noticed substernal dull pain. This increased slowly in severity for two months, when he began to experience difficulties in swallowing solid foods, then liquids, and finally, regurgitation of everything, including water, for a few weeks previous to admission. Rapid emaciation occurred with a loss of twenty-five pounds in weight.

Œsophagoscopy. With the patient in the supine position, under ether anæsthesia for the gastrostomy contemplated by Dr. Frazier, the 10 mm. œsophagoscope was introduced for a distance of 26 cm. from the line of the upper teeth, where the lumen of the œsophagus was obliterated by a red papillomatous growth. This growth (Fig. 2), evidently carcinoma, was situated mostly on the anterior and right lateral wall of the œsophagus. A small section removed for microscopical examination presented the appearance seen in the photomicrograph (Fig. 7) and confirmed the diagnosis made by inspection.

CASE 3. J. K., age 41, was admitted to the Episcopal Hospital on November 27, 1908, complaining of difficulty in swallowing of eight months' duration. The history was very meagre. He was pale and emaciated and presented the typical appearance of a phthisical patient. He suffered from a chronic cough attended with a very profuse mucopurulent expectoration. There was slight roughening of the breath sounds at the right pulmonary apex, and numerous large moist râles were present throughout both lungs. He could swallow liquid foods, but the act seemed to provoke a paroxysm of coughing followed by vomiting.

Œsophagogastroscopy. The patient, supported between the knees of an assistant, was seated upon a low stool. Under cocaine anæsthesia the 10 mm. tube was introduced through the œsophagus to the mid-mediastinal region, where it encountered an obstruction (Fig. 3), appearing as a hard, smooth tumor invaginating the lumen. The mucous membrane covering the mass was entirely normal. After prolonged perseverance the scope was glided by this stenotic growth, having its origin evidently from the lymph nodes of the mediastinum. Tuberculosis, with metastasis to these nodes, or lymphosarcoma, was the first thought, but this was quickly dispelled as the tube approached the cardia of the stomach, and the view depicted in Fig. 4 made its appearance. The only conclusion was carcinoma with metastasis to the mediastinal lymph nodes, producing stenosis by their encroachment upon the œsophagus. A small section of tissue taken for microscopical study confirmed the gross appearance and presented the condition seen in the photomicrograph (Fig. 8).

The patient died two weeks later. The autopsy by Dr. C. Y. White revealed a large ulcerative carcinomatous mass, extending completely around the œsophagus and situated 4 cm. above its lower end, but not invading the cardiac end of the stomach as I thought. The mediastinal lymph nodes were enlarged, carcinomatous and anthracotic.

CASE 4. B. C., age 55, was admitted to the University Hospital February 16, 1909, with the following

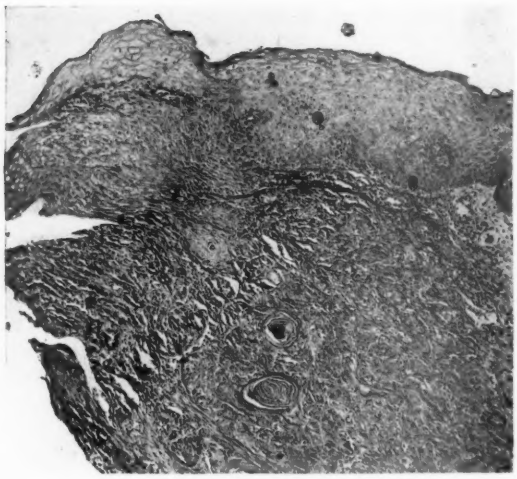

Fig. 7.

history: Seven months previous he noticed pain in epigastrium and region of heart. During the two months preceding admission the pain became more severe and was accompanied by sour eructations, irrespective of food. Emesis finally occurred following eating, and he states he had lost 15 to 20 pounds in weight.

Œsophagogastroscopy. Patient was placed in the supine position with the shoulders slightly elevated, and the 10 mm. tube was passed through the introitus œsophagi under cocaine anæsthesia. The œsophagus was essentially normal save for an abrasion of the mucous membrane at the level of the cricoid cartilage, as the result of the previous passage of bougies. At a distance of 23 cm. a few large and small venous varicosities were visible (Fig. 5). At the cardia an irregular, elevated, ulcerated area of mucous membrane, depicted in Fig. 6, was seen. The condition was obviously carcinoma from the appearance of the growth, and three days later Dr. Frazier performed gastrostomy, when a mass 4 or 5 cm. in diameter, macroscopically carcinomatous, was found at the cardiac end of the stomach.

From an analysis of the cases which it has been my fortune to examine and study by the œsophagoscope and gastroscope, the following conclusions seem justifiable:

1. The straight tube is the most useful model of instrument which has ever been devised for purposes of diagnosis of lesions of the œsophagus and stomach, and its use is attended with uniform success.

2. By virtue of the fact that the instrument is always introduced through the lumen of the œsophagus under direct inspection, no danger can arise from injury to adjacent ulcers, venous varicosities, aneurism, neoplasm, etc.

3. Resort to the employment of the gastroscope offers a method for the early differential diagnosis of cancer when the symptoms are vague and it is still in the curable stage.

4. General anæsthesia should always be used for gastroscopy and rarely for œsophagoscopy.

5. Œsophageal bougies, coin catchers, and horsehair probangs, have no place in modern surgery.

6. In addition to advantages in diagnosis, the use of the scopes for purposes of treatment, as in the removal of foreign bodies, is inestimable.

7. Endoscopy by the use of the straight hollow tube of the Jackson type, discloses a new era in the diagnosis and treatment of affections of the upper alimentary tract.

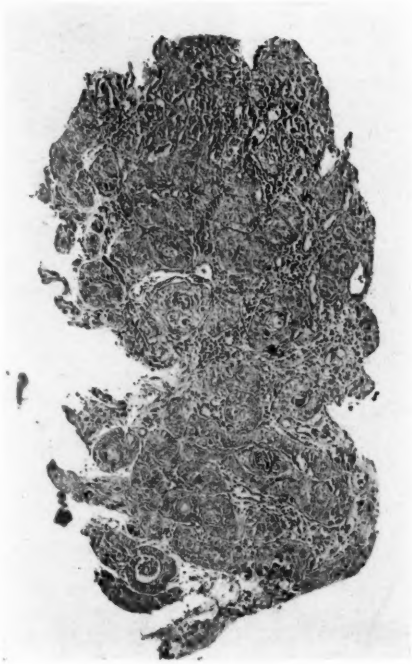

Fig. 8.

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BONE SARCOMA[1]

Observations on Twenty Bone Sarcomata

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ALTHOUGH the literature abounds in reports of clinical cases of bone sarcoma, very few systematic studies of the pathology, both gross and microscopic, have been made. It has been my fortune to have seen some twenty-five cases of sarcoma of the long and flat bones during the past two years, and a study of twenty of these has led me to believe that the conception of these tumors as propounded in the text-books leaves a great deal to be desired, so that it may not be amiss to point out the features characteristic of my own specimens with a view to clearing up some of the doubtful points in their mode of growth. The gross specimens which I shall demonstrate to you will, I hope, when their important structural characteristics are considered, make it evident that these interesting tumors exhibit a great variety of morphological types and present many vagaries in the course of their development; but that notwithstanding this, they can be grouped in such a way that a fairly definite idea of the most important varieties can be obtained. Doubtless when a larger amount of material is examined still other forms will be encountered; however, those which have come under my observation probably represent some of the most common and most interesting types. It shall be my purpose then to describe only those specimens which I myself have been able to study and to draw only those conclusions that a critical study of these may warrant, leaving out of consideration the work that may have been done by others in this field with the exception of that which pertains to certain elementary facts in the pathology of sarcoma.

For a thorough comprehension of the subject it is expedient to classify the sarcomata either from the standpoint of their histopathology or from the standpoint of their seat of origin. It was Virchow who first divided them into myelogenous or central, and into periosteal or peripheral varieties, and this classification is still generally employed. A perusal of the text-books makes it apparent that much confusion exists as regards histological nomenclature. Thus the English authors described the giant-cell sarcomata as *myelomata*, because they have their inception in the marrow cavity, and on the other hand the German authors employed this word for a wholly different kind of growth. During the past few years the studies of Borst have thrown a great deal of light on the histogenesis of the connective tissue neoplasms, and the elementary facts in this

[1] Read before the Orthopedic Section of the Academy of Medicine, January 15, 1909. From the Department of Surgical Pathology, Mt. Sinai Hospital.

classification are so valuable that I wish to state them briefly here. Sarcomas belong to the connective tissue tumors, which are either benign or malignant. The benign tumors are characterized by the fact that the elements which constitute them become fully developed and ripe; thus, a fibroma is composed of connective tissue elements that become mature and resemble in every way the fibrous tissue found elsewhere in the body. Similarly the myomata, neuromata, chondromata, and osteomata represent typical fully matured connective tissue growths. The sarcomas do not reach this stage of development. In granulation tissue we can study the morphology of the various unripe connective tissue cells; in it we see the youngest cells typified by the round cell; we see the round cell give way to the spindle cell or fibroblast; we see this latter developing intracellular substance and fibrous tissue, and finally find a conversion of richly cellular and vascular structure into firm mature scar or cicatricial tissue. If we suppose this normal process to be interrupted at any stage so that round cell does not develop into the fibroblast or so that the fibroblast remains a spindle cell and fails to produce connective tissue, then we have a process just as it occurs in sarcoma. Borst, therefore, wishes to classify the sarcomas according to their stage of development and type of differentiation into a young mature variety exemplified by a round or spindle-cell sarcoma and into more highly developed forms in which intercellular substance is present and in which pictures more or less resembling other varieties of connective tissue, such as cartilage, bone, and muscle tissue are elaborated. The sarcoma which ripens to the extent of producing cartilage should then be called a chondro-sarcoma, or chondro-blasto sarcoma, a tumor which forms bony tissue, osteo-sarcoma (osteo-blasto sarcoma), one in which the spindle cells become differentiated into muscle fibres, myo-sarcoma (myo-blasto sarcoma), and so on through the whole list of connective tissue varieties. Noting the different kinds of connective tissue that are normally present in bone, that is to say, in the periosteum, in the cortex, in the marrow, and in the extremities and ends of the bones, we can predict to a certain extent the kinds of tumor that may here develop. Osteo-sarcoma, therefore, would not be the proper appellation for all the tumors arising in bone, and should be applied only to that particular form in which the inherent potentiality to produce osseous ground substance or matrix is manifested. Thus from the marrow cells we have the true *myelomata* of the Germans. These usually occur in a number of bones as multiple, sharply circumscribed, soft tumors produced by the proliferation of atypical marrow cells. From the periosteum which contains spindle cells, we should expect the development of the spindle-celled or less mature round-celled sarcoma. From those elements in the bone which are osteogenetic we should predict the formation of osteo-blastic tissue, osteoblasts, giant cells, and bone ground substance, or, by a reversion to the immature types, a round- or spindle-celled tumor could arise.

For the sake of clearness, it may be well to glance at the tabulated classification of sarcoma that I have taken from Borst's paper and very slightly modified. This may also be of value in a mnemonic way.

If we keep in mind these fundamental facts, namely, that the sarcomas should be classified according to the degree of maturity attained and according to the type of intercellular substance elaborated, it will not be difficult to designate properly every tumor that we encounter. And thus a tumor which produces osteoid, osseous, or cartilaginous tissue, should belong to the osteoid, osteo-, or chondro-blasto sarcomas even though a reversion to an immature form composed of round, spindle, or polymorphous cells, be found in parts of the neoplasm. In this way much confusion can be avoided, and a more definite idea of the similarities in mode of development can be obtained, than if all sarcomas in which more than one type of cell occurs, are considered under the appellation "mixed-celled sarcoma." This has too often been the case in the writings of previous authors and is in part accountable for the fact that a number of the very interesting data (which seem to me characteristic of certain histologic types) have been overlooked in the past. These shall be referred to later in the exposition of my subject.

Although the histologic diagnosis and clas-

CLASSIFICATION OF CONNECTIVE TISSUE TUMORS

No.	MOTHER TISSUE	RIPE FORMS (Homoeotypes)	UNRIPE FORMS (Heterotypes)	
			Very Immature	More Mature
1	Fibrous tissue	Fibroblastoma [1]	Round — or spindle-celled sarcoma	Fibroblasto-sarcoma
2	Myxomatous tissue	Myxoblastoma	Stellate-celled sarcoma (star shaped)	Myxoblasto-sarcoma
3	Fat tissue	Lipoblastoma	Round-celled sarcoma (without fat)	Lipoblasto-sarcoma
4	Cartilage tissue	Chondroblastoma	Cellular sarcoma (without cartilage)	Chondroblasto-sarcoma
5	Bone tissue	Osteoblastoma	Cellular sarcoma (without bone)	Osteoblasto-sarcoma
6	Vessel tissue *a*. Lymph *b*. Blood	Angioblastoma *a*. Lymphangioblastoma *b*. Hemangioblastoma	 Flat-celled and alveolar sarcoma Flat-celled and alveolar sarcoma	Angioblasto-sarcoma *a*. Lymphangio *b*. Hemangio
7	Pigment tissue (Chromatophores)	Melanoblastoma	Unpigmented sarcoma Leucosarcoma (round, spindle, alveolar)	Melanoblasto-sarcoma
8	Lymphatic tissue	Lymphocytoblastoma [2] *a*. Lymphatic leukemia *b*. Pseudo leukemia *c*. Lymphatic myeloma	Round-celled sarcoma	Lymphocytoblasto-sarcoma (Lymphosarcoma [3])
9	Myeloid tissue	Myelocytoblastoma [4] *a*. Myelogenous leukemia *b*. Myeloma	Large-celled sarcoma (round or giant)	Myeloblasto-sarcoma [5] (myelosarcoma) (myelosarcomatosis)

[1] Corresponds to "fibroma" in ordinary usage.
[2] Solitary or generalized; homoeotypical tumor formation composed of typical lymphatic tizsue.
[3] Solitary or generalized form; so-called lympho- and leucosarcoma and lymphatic form of chloroma.
[4] Solitary or generalized; homoeotypical.
[5] Solitary or generalized; myelosarcomatosis; myeloid form of chloroma.

sification, when once understood, offers but little difficulty, the problem of arranging the bone sarcomas into the two varieties central or myelogenous, and peripheral or periosteal, is at times so intricate and perplexing, that only a very complete study of the specimen, from a number of points of view, can lead us to a decision in this matter. As we shall see from the description of our own tumors, many of the sarcomas by virtue of their extensive and exclusive development in the medullary cavity, leave no doubt in our minds as to their seat of origin. Others, however, have attained remarkable dimensions outside of the bone, and show but a small area of sarcomatous tissue in the marrow. In these, the question as to primary location is not so easily answered. However, I may now anticipate by saying that probably most of these tumors are of central origin. For, whereas there is plenty of evidence in support of the view that perforation of the substantia compacta by a small intramedullary growth may be an early occurrence, all our data and observations on the mode of neoplastic advance point against the likelihood of penetration and invasion of the bone from without inwards by the extraosseous tumor, in most of the specimens I shall later describe. But there are still other varieties in which there is an extensive spindle-shaped, bone-encasing tumor, highly suggestive of being of periosteal origin, lifting up the periosteum by its advance and diffusely infiltrating that portion of the bone which it envelops. Here special study

Fig. 1. Posterior view of giant-celled sarcoma of the tibia.

Fig. 2. X-ray photograph of the dissected specimen seen in Fig. 1.

is required; indeed, a consideration of radiograms of serial bone sections, as suggested by Rumpel, seems to be the only reliable method at our disposal for the investigation of this phase of the subject.

Ribbert in his recent study of the growth of bone sarcoma concludes that most of these neoplasms arise in the medulla and cancellous extremities of the bones, and that probably a very small proportion is traceable to foci under the periosteum and in the cortical layers. He rejects the terms myelogenous and periosteal and says that at the present state of our knowledge "central" and "peripheral" had better be employed. It would have taken us too far to have included the results of our own studies[1] along these lines, in the present publication, and we have therefore reserved a consideration of this phase of the subject for some future time, when our conclusions shall have assumed a more definite shape. Here it will suffice to reiterate that in our series the majority of sarcomas had their origin within the limits of the bone, most of them having their inception either in the spongy extremities or in the substantia compacta of the cortex.

[1] These will be reported by Miss Adele Oppenheimer and the author.

DESCRIPTION OF THE TUMORS

The preponderance of sarcoma of the femur noted by a number of authors, was also seen in our series in which the distribution was as follows: femur 10, tibia 4, fibula 3, humerus, metacarpal, and rib each 1. Adopting the suggestion of Ribbert who, as already mentioned, recognized a central variety that originated in the bone marrow, and a peripheral that arises in most instances in the outer layers of the substantia compacta (possibly also under the periosteum), we may divide our specimens into 19 of the central and 1 of the peripheral[2] variety.

[2] If we were to include tumors beginning in the deepest layers of the substantia compacta in "peripheral" variety, then a larger percentage would belong to this group.

Inasmuch as no distinct line of division between central and peripheral sites of origin is established in Ribbert's new classification, it will be readily appreciated that a categorical separation into these two classes would be difficult, if not almost impossible to carry out.

1. EXPANSIVE SARCOMAS OF THE EXTREMITY OF LONG BONES

Let us first direct our attention to the giant-celled sarcoma which usually arises in the neighborhood of the epiphyseal line. An exquisite example is that afforded by the specimen represented in Figs. 1 and 2 (case 1) where the upper end of the tibia is seen to be expanded into a large irregularly globular mass. Its walls are made up of a very thin layer of tumor and bone, and the interior shows a cavity filled with hæmorrhagic and disintegrated tumor tissue and altered blood. Although the growth has attained considerable dimensions and the cortex has been greatly thinned out, being practically absent in places, the joint surface is free, an immunity against the growth of bone sarcoma that is rather characteristic. The expansive growth, the absence of infiltration in the shaft, the tendency to the formation of cavities filled with hæmorrhagic tumor masses, and the relative benign nature are distinguishing features of this group of sarcomas.

Resembling the last specimen in the absence of malignant traits, is the cystic sarcoma depicted in Fig. 3 (case 2). Here the lower end of the femur is expanded in a fusiform fashion, in part by the presence of a large osteoma purported to have existed for many years, and in part by the conversion of a portion of the shaft and condyles into a multilocular cavernous space. Here, too, very little tumor tissue is left, most of it having been removed in the course of a number of conservative operations in which curetting and packing had been done. That which remains, however, shows in places typical giant-celled sarcoma, and in others degenerate myxo-sarcoma. Nowhere do we see any tendency to extension along the marrow cavity, nor any tendency to penetrate the bony cortex. For, although more than two years old, the neoplasm has not produced any extra-

Fig. 3. Interior of a longitudinal section of a cystic, giant-celled and myxo-sarcoma of the lower end of the femur; on the right a lenticular osteoma; below, a cavity in one of the condyles; above this a larger cavity with a little hæmorrhagic tumor tissue.

osteal growth, and even in the condyles themselves, no change could be found other than a total disintegration of the cancellous tissue and a transformation of this into cavities filled with glairy fluid. We have here, therefore, another interesting variety of giant-celled sarcoma, peculiar in the production of cystic spaces. This tumor may possibly be regarded by some as an example of tumor formation in a bone which was the seat of so-called *osteitis fibrosa* (Recklinghausen).

Fig. 4. Osteoblasto-sarcoma of the femur viewed from below, the patella being reflected upward so as to show the joint; above the condyles the expansive growth of the tumor is seen.

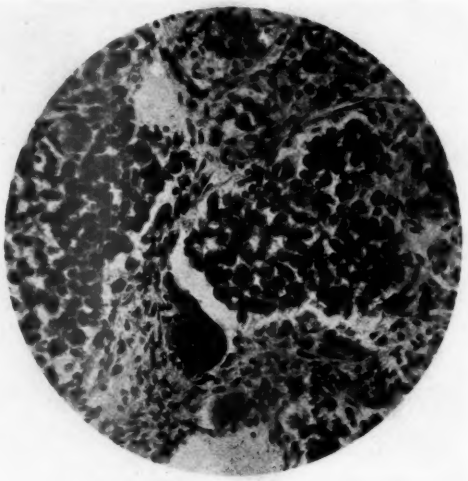

Fig. 5. Osteoblasto-sarcoma. Solid alveoli composed of tumor cells with eccentric nuclei, resembling osteoblasts; giant cells resembling osteoclasts. (Bone formation in metastases).

2. EXPANSIVE SARCOMAS OF THE SHAFT

Expansive tumors of the lower end of the femur, may, however, be of a very malignant type, although exhibiting many of the features of the giant-celled variety. In Fig. 4 (case 3), we have the femur of a case in which a very large globular tumor originating in the medullary cavity caused general enlargement of the lower part of that bone, finally breaking through posteriorly, adding a large ovoid extra-osteal mass to the bony distortion. Here, again, the joint surfaces are intact, whereas perforation of the bony cortex above the intercondyloid notch in front, had already occurred. Microscopically there is a predominance of cellular elements that closely resemble true osteoblasts arranged in solid alveoli, Fig. 5. Many giant cells are interspersed between the alveoli. Several months after amputation of the limb the patient succumbed and metastatic nodules showing active bone proliferation were found in the lungs. This tumor, therefore, is an exquisite example of sarcoma composed of osteogenetic elements which only manifested their ability to produce the ground substance of bone in the metastases, whereas the cells corresponding to osteoblasts and osteoclasts without their characteristic intercellular substance preponderated in the primary growth.

Fig. 6. Skiagram showing sarcoma of the fourth metacarpal bone, and pathological fracture.

Fig. 7. Chondro-sarcoma of the femur; longitundinal section; tumor occupies most of shaft, infiltrates neck; note soft extraosteal growth under the neck, and preservation of the substantia compacta.

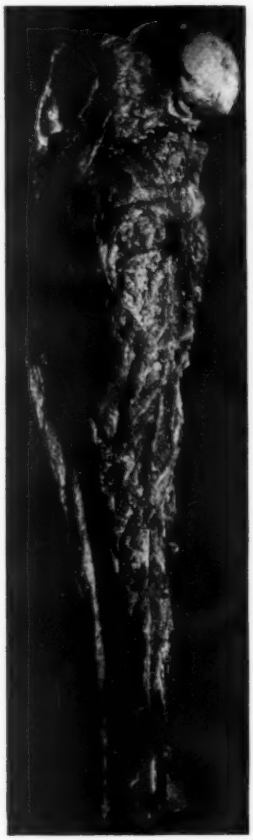

Fig. 8. Chondro-sarcoma (same as Fig. 7), antero-external view.

Those tumors in which there is a formation of atypical cartilage, so-called chondro and chondroid sarcomas, are exemplified by specimens pictured in Fig. 6 (case 4) and Fig. 7 (case 5). In the first of these a pathological fracture of the fourth metacarpal had occurred at a point where the tumor had caused distention and destruction of the cortex. A short distance below the head of the bone the marrow cavity was occupied by a moderately hard growth having a pearly appearance on section. Corresponding to its site very slight distention of the cortex with thinning of the ventral and dorsal aspects had taken place. Clinically there had been no signs of the presence of the tumor and it was only after a vigorous pull on the hand had caused fracture of the diseased bone, that attention was called to the part. Pathological fracture was suspected, but it was not until a skiagram had been taken that a diagnosis of neoplasm was definitely made. Histologically we find here atypical cartilage with a preponderance of cells in places, the picture giving the impression of a rather benign type of sarcoma. One year and a half after resection of the metacarpus was done, no evidence of metastasis or recurrence could be detected.

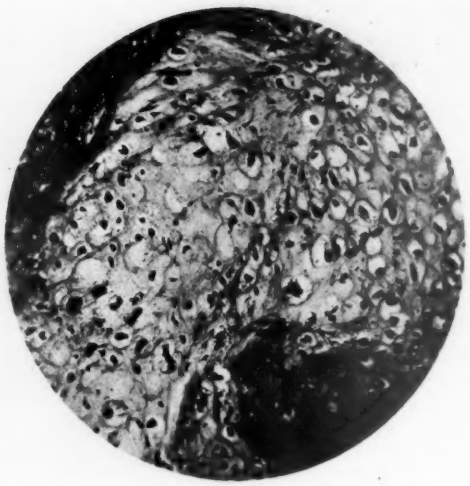

Fig. 9. Photomicrograph of a section taken from specimen of chondro-sarcoma of the femur Fig. 7).

If the well circumscribed, practically benign, sarcoma just described, be regarded as a transition from a pure chondroma to sarcoma, the large, rapidly growing, metastasizing tumor of the femur shown in Figs. 7 and 8 (case 5) will demonstrate how malignant the chondro-sarcomas may be. Here the femur in its upper two-thirds is converted into a fusiform tumor in which the bony limiting wall is hardly diminished in thickness, and, for the most part, well preserved, and which is filled with tumor tissue that has already undergone considerable regressive change. In the middle of the fusiform enlargement there is a large cavity filled with necrotic and hæmorrhagic tissue. In many places, however, the true nature of the neoplasm becomes apparent, for the pearly, glistening masses resembling hyaline cartilage that are still adherent to the walls and niches of the cavity suggest the cartilaginous nature of the growth. The same glistening masses infiltrate the cancellous bone of the neck, and can be traced far into the head of the bone. Just above the lesser trochanter and under the neck of the tumor there is a nodular, soft, extraosteal mass which communicates through a small perforation with the intramedullary growth. Its cut surface shows it to be of a different nature, its appearance being that of a soft and richly cellular sarcoma. Microscopically the main mass presents the typical picture of chondro-sarcoma (Fig. 9) whereas the smaller growth outside of the bone is made up of a multitude of cells of various sizes and shapes belonging to the so-called polymorphous or mixed-celled sarcomas in which no differentiation into higher forms with the production of specific ground substance has occurred.

Here, then, we have a diffusely growing endosteal growth that has caused fusiform expansion of the shaft of the femur, that has shown its infiltrating tendencies by its extension through the cancellous bone of the head and neck above, and marrow cavity below, and which reveals its malignant tendency by the fact that outside of the bone an unripe rapidly growing neoplasm, rich in cells, is being produced. This reversion to lower types is not an uncommon incident in the life history of the malignant connective tissue tumors. We see it in the metastases that appear at points widely separated from the primary growth or even in parts of the primary tumor itself. When the inhibiting influence and restrictions to the growth afforded by the bony cortex are lost, this proclivity to rapid proliferation, this metamorphosis into the lower, highly cellular types, is frequently manifested. It must always be regarded as a sign of great malignancy.

3. DIFFUSE, INFILTRATING, ENDOSTEAL SARCOMAS

Although the central tumors very frequently evidence the expansive characteristic that is illustrated in the three tumors of the lower extremity of the femur and the two chondro-sarcomas just described, we must not gain the impression that this mode of growth is an essential quality. On the contrary, in our series of central sarcomas it was present (only) five times, and I wish now to describe briefly four neoplasms that develop in quite a different way. In these a diffuse infiltration or substitution of the marrow by sarcoma takes place. There is no distention of the shaft, and erosion of the limiting *corticalis* goes on *pari passu* with the growth of the neoplasm. A very good example of this type is to be found in the diffusely growing fibro-sarcoma (spindle-celled) of the upper end of the femur depicted in

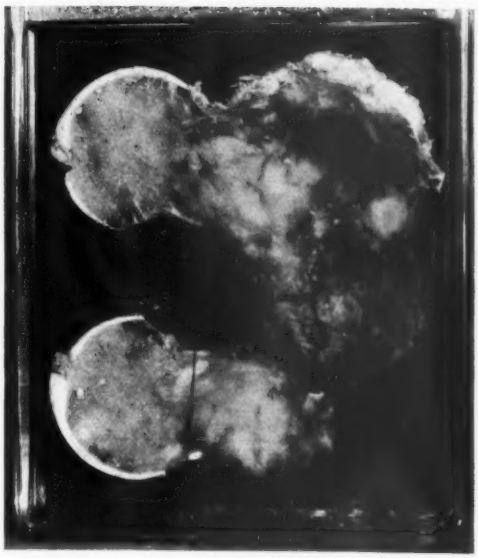

Fig. 10. Head and neck of the femur infiltrated by a fibro-sarcoma.

Fig. 11. Shaft (reversed) of specimen Fig. 10 the oblique ragged edge representing the fracture line; this fits on the specimen Fig. 10; note intramedullary extension of the tumor.

Figs. 10 and 11 (case 6), where the cancellous tissue of the neck and trochanter regions are completely replaced by a dense fibrotic tumor, and where even the marrow of the upper part of the shaft has been invaded to the extent shown. Because of the absence of any considerable enlargement of the bone, we can readily appreciate how considerable destruction of bony tissue may occur before any clinical symptoms develop, and will not be surprised by the statement that in this case fracture of the bone upon very slight injury was the first symptom.

In another case (7) where the location of the neoplasm was almost identical with the last, the perforation of the bone and invasion of the soft parts caused a small swelling, which, on account of the tenderness and other suggestive general clinical signs, was diagnosticated as a chronic inflammatory process, probably of tuberculous nature. In spite of a number of osteotomies which were always attended with very profuse hæmorrhage, a cure was not effected. The specimen, which I obtained post-mortem, showed myelogenous infiltration with a spindle-celled sarcoma of a variety that produces soft, leaf-like, fungous masses when developing free and untrammeled by surrounding tissues.

A very interesting combination of sarcoma and chronic osteomyelitis was found in the tibia of a young woman who had had an acute osteomyelitis nine years previously. On admission to the hospital it appeared that a recurrence of the old process had recently taken place. At the operation intense osteosclerosis with practically complete obliteration of the marrow cavity of the tibia by dense bone and considerable periosteal bone formation were seen to be associated with a subperiosteal abscess. Although all the clinical signs indicated the existence of an inflammatory process alone, a very small focus of softer tissue appeared to me to be sufficiently suspicious to warrant histological examination; the excised piece proved to be round-celled sarcoma. The development of the tumor from this time on was extremely rapid, and in a few weeks the

Fig. 12. Round-celled sarcoma of tibia associated with chronic sclerosing osteitis and acute osteomyelitis; longitudinal section; a small portion of upper extremity is intact; the middle of the shaft is laid open (by osteotomy) and the tumor is growing on the surface into the granulations.

Fig. 13. Same as 12; antero-external view; the ovoid sectioned mass represents an extraosteal growth due to penetration from within outward.

upper part of the shaft of the tibia was changed into a large spindle-shaped mass, the neoplasm infiltrating the muscles of the calf of the leg, Figs. 12 and 13 (case 8). In this case, as a reference to the skiagram (Fig. 14) will show, the endosteal tumor was doubtless impeded in its growth by the dense masses of sclerotic bone tissue that replaced the medullary cavity, a circumstance which we shall again have occasion to observe in the study of the so-called "osteoid" type of bone sarcoma.

A fourth specimen of the diffusely infiltrating variety was seen in the case (9) of a round-celled [1] sarcoma of the shaft of the humerus. The marrow cavity was involved to the extent shown in the X-ray photograph (Fig. 15) and no appreciable expansion of bone was caused by the growth. This is another instance of the type in which pathological fracture would probably have occurred upon very slight provocation.

[1] For our purposes it will suffice to designate this tumor as "round-celled," although in many places the morphology of the cells resembles that of osteoblasts; perhaps it is an undifferentiated "osteoblasto-sarcoma," but not in the sense of producing osseous ground substance.

4. DESTRUCTIVE, DISSOLUTIVE, NON-EXPANSIVE SARCOMAS

A very rapidly growing and destructive variety of sarcoma is that which clinically is most frequently found to affect the upper extremity of either the fibula or the tibia, where its growth results in a fusiform enlargement of the upper part of the leg, rather more often in the region of the fibula than in that of the tibia. Although my material was collected from but four cases, three of which shall be included in this study, I have had occasion to see three others belonging to this type.

Fig. 14. Skiagram of 12 and 13; shows dense shadow in the shaft, due to osteosclerosis; periosteal bone formation. The beginnings of tumor formation lying in the dense bone cannot be seen.

Originating in the upper end of the diaphysis, these tumors — usually small spindle- or round-celled — cause rapid disintegration of the cancellous bone and soon make their way out into the soft parts. Some, however, by virtue of the proliferative phenomena evoked in the periosteum, are apt to bring about that peculiar admixture of softening and bony sclerosis

Fig. 15. Round-celled sarcoma of the shaft of the humerus; diffusely growing, destructive type.

which is so characteristic of certain other bone sarcomas.

As an example of the first of these, let us glance at the skiagram of a round- and spindle-celled sarcoma (case 10) of the upper end of the fibula (Fig. 16). The end of the bone had been converted into a large fusiform soft tumor mass composed of hæmorrhagic and partly necrotic sarcoma tissue in most of which not a vestige of the osseous elements could be detected. At its upper part, however, a thin shell of bone remained; and below, too, the eroded and partly infiltrated shaft bore testimony to the truth of the assumption that the origin of the growth was to be sought somewhere in the center of the upper part of the shaft. The absence of extensive infiltration of the medullary cavity, of any considerable periosteal bone formation, and the complete disintegration of the bone, are circumstances worthy of note.

Perhaps an earlier stage in the development of these neoplasms is that depicted in Fig. 17 (case 11) where the diagnostic earmarks of

Fig. 16. Destructive round-celled type of sarcoma of fibula. Skiagram of tibia and fibula.

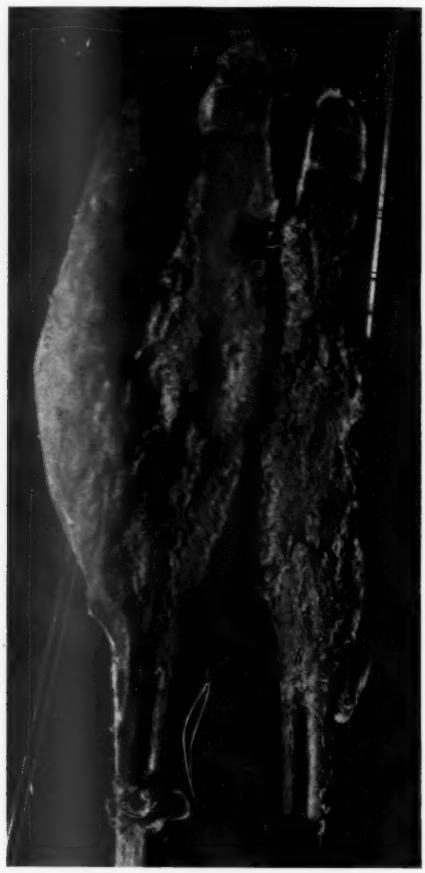

Fig. 17. Round-celled sarcoma of the fibula; note the detachment of the periosteum under which there is a wedge of dense, newly formed bone at the lower limit of the tumor.

bone sarcoma are even more pronounced than in the last specimen. Here there is a similar tumefaction with the formation of a large lenticular, sessile, extraosteal tumor mass, and neoplastic infiltration of a part of the shaft of the fibula. A significant feature is the production of new bone, both in the shaft and under the periosteum. Originating somewhere in the deeper cortical lamellæ of the upper part of the fibula, the neoplasm has grown in two directions, through the cortex, and outward under the periosteum. Where the growth has invaded and destroyed osseous tissues, namely, in the substantia compacta, and cancellous extremity, there a moderate amount of reactive bone proliferation from pre-existing osseous elements has taken place, so that a peculiar admixture of new bone, resorbed bone, and soft tumor have resulted. The phenomenon of new bone production belongs *par excellence* to the "osteoid" tumors which I shall later describe. More interesting and suggestive, from the standpoint of diagnosis, is the manner of growth under the periosteum. After penetrating the cortical lamellæ the tumor lifts up the periosteum and causes proliferative changes to take place. These manifest themselves in hyperplasia and in the formation of new bone, the lamellæ of which are arranged more or less perpendicular to the plane of the periosteum

Fig. 18. Photomicrograph of the detached periosteum of case shown in Fig. 17. Above, superficial layers of periosteum; on the left three trabeculæ of new bone; on the right one large trabecula of bone and some invading tumor cells.

(Fig. 18). Thus we see on section (Fig. 17) a wedge of new bone at the lower limit of the fusiform tumor. This gives a characteristic shadow in Roentgen photographs. The detached periosteum can be traced over a large part of the surface of the growth, and its newly formed osseous trabeculæ can be detected in many places. Where the neoplasm has advanced farthest there the new formed bone has in its turn been destroyed so that only microscopic evidences of its presence are left.

In a third case (12) belonging to this group, endosteal bone formation was absent, although the subperiosteal bony deposits were found to be laid down at the usual sites and in the typical fashion. The sarcoma was of the small round-celled variety [1] and involved the upper part of the shaft of the fibula. There was extensive resorption of bone and a diffuse infiltration of the muscles of the calf, the latter having been favored, in all probability, by an exploratory operation done in another hospital, some weeks previous to the resection of the tumor.

Summing up the peculiarities of this variety of bone sarcoma, we may say that these are immaturity (cellular without specific intercellular substance), rapid growth, extensive destruction of bone with or without endosteal bone proliferation, and subperiosteal osseous deposits.

[1] I have grouped this as a round-celled sarcoma although in places there was a distinct alveolar disposition of spindle-shaped elements, further studies will be made on these atypical forms.

5. SCLEROSING (CALCIFYING) ENDOSTEAL

I wish now to give especial attention to an interesting and important group of sarcomas which belong to the so-called "osteoid" variety, both because of the barrenness of the literature on this subject, and because my studies have led to the recognition of a number of useful diagnostic points. We are wont to designate those sarcomas as "osteoid" in which a homogeneous matrix comparable to the ground substance of bone is elaborated. This may or may not include tumor bone cells, and gives the picture of an atypical non-calcified osseous tissue. There are great variations in the amount of osteoid ground substance; it is either sparsely distributed amongst numerous cellular elements, or it may be present in considerable quantities, so as to form a marked feature in the histological picture. The tendency to calcification of the osteoid tissue is responsible for many of the essential microscopic features of these growths.

In Figs. 19 and 20 the histology of typical osteoid sarcomas is shown. Here there is no lime deposit, the tumor remains soft, and tissue belongs to the immature osseous type. When calcification of the ground substance occurs, then the next stage in bone production is attained. However, the deposit of lime is usually so irregular, and may be so great in amount, that portions of tumor become converted into petrified or calcific masses in which the architecture of the neoplasm becomes almost wholly effaced. It may not be amiss to insert here the bizarre picture presented by the calcific process in one of the tumors reproduced in Fig. 21, for it shows a coralline structure unlike anything seen in similar pathological processes. At times we find islands of atypical cartilaginous or "chondroid" tissue in which lime deposition may also take place. When such tumors are unhampered by the deterring influences afforded by the dense walls of bone, namely in the metastases and in the extraosteal masses, mutation of type frequently

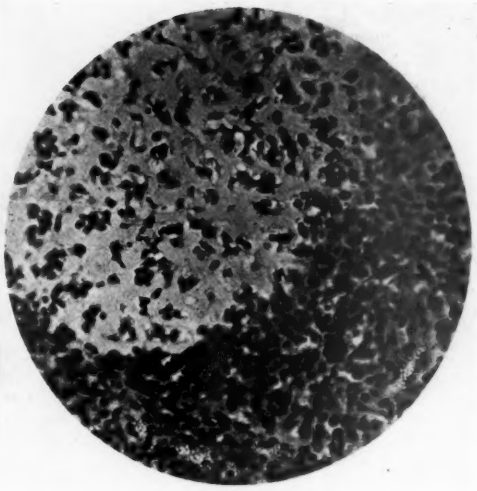

Fig. 19. Photomicrograph of the soft portion of an osteoid sarcoma; upper left half occupied by osteoid substances in which tumor bone corpuscles are enclosed.

occurs, for rapidly growing mixed-celled, soft tumors with or without indications of osteoid ground substance substitutes the more highly differentiated bone-forming type.

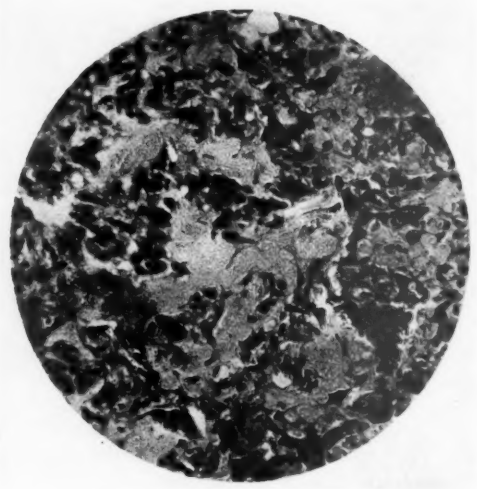

Fig. 20. Osteoid sarcoma showing a typical "tumor" osteoblasts, pale, homogenous, soft osteoid tissue with darker areas of beginning calcification.

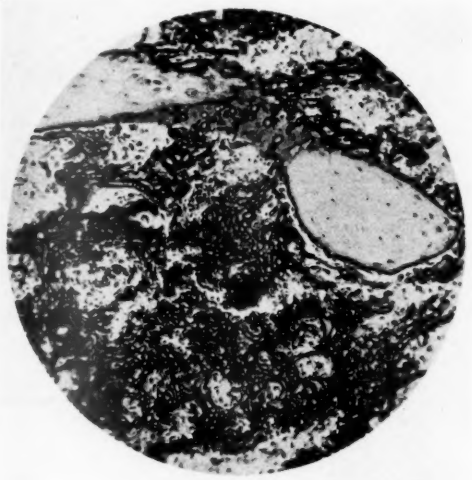

Fig. 21. Diffuse and extensive calcification in an osteoid sarcoma, coralline structure exhibited.

It would lead me too far from my theme to give a detailed account of all the histological features of these tumors. Suffice it to say here that the osteoid material should be regarded as an immature neoplastic ground substance which indicates to us the specific potentiality of the cells that are responsible for its production, and further that it is most important for our clinical purposes to recognize the three forms assumed by these growths, namely, the typical soft osteoid, the calcific irregularly ossified, and the polymorphous soft variety; for each of these grows in its own peculiar way.

Let us briefly describe five tumors of this class that exhibit the characteristics referred to above. Four were situated at the lower end of the femur [1] and one occupied the upper end of the tibia. All had their inception in the cancellous bone near the extremity of the diaphysis, and had evidently grown for some time, showing, upon removal, such marks of age as extraosteal tumors of considerable size and extensive calcification.

In Fig. 22 (case 13), we have an osteoid sarcoma of the femur that took the form of a large, lenticular, extraosteal tumor riding on the

[1] Since the writing of this paper I have studied another example of "osteoid" sarcoma occuring in the lower end of the femur.

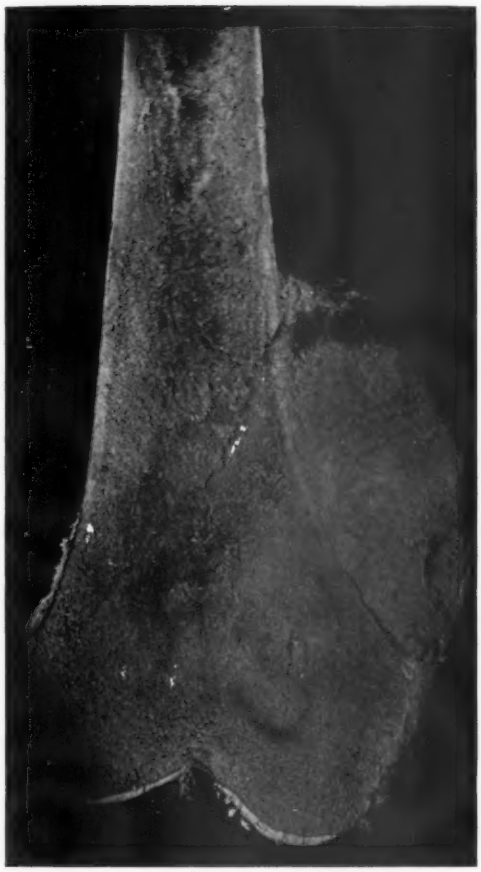

Fig. 22. Osteoid sarcoma of the femur.

shaft just above the internal condyle. Upon casual observation one would entirely overlook the fact that the softer mass outside of the bone represents but an extension of a neoplasm originating in the cancellous bone. Close inspection reveals the fact that a large part of the internal condyle and some of the diaphysis merging into the condyle, are converted into dense, partly calcified osteoid sarcoma. A better notion of these pathological changes will be obtained by a reference to Fig. 49 of the schematic series to be described later on.

Although this specimen well illustrates the central origin, the tendency to perforation of the cortex, the extraosteal development and the early stages of intramedullary sclerosis — characteristics of the osteoid tumors — a still more striking example will be seen in the sarcoma of the tibia shown in Figs. 23 and 24 (case 14). Here there was a history of the appearance of a swelling over the outer aspect of the upper part of the leg within a very few weeks. Corresponding to this we see the mass springing from the antero-external surface of the tibia. In the illustration this is much diminished in size, both because of the detachment of a superficial shell and because of the shrinkage due to the fixation.

The section of the tibia exhibits a number of remarkable features. The upper part of the diaphysis below the epiphyseal line, for a distance of about four and a half inches is transformed into a petrified mass. In this the normal bony texture is almost wholly destroyed, indications of it being everywhere absent, except in a narrow zone just below the epiphysis (Fig. 24). Traced downward the stony substance merges imperceptibly into semi-hard tumor, and this in turn into a soft plug of sarcoma that fills the medullary cavity for an inch below the area of sclerosis. At the site of the extraosteal growth the dense central portion fuses so intimately with the remnants of the cortical lamellæ that these have almost disappeared; indeed the calcific substance is seen to pass over into the soft tumor, outside of the bone, where it forms a lobulated nucleus or stem around which the softer tissue is arranged, in plant-like fashion.

Without histological studies, some doubt would arise as to the neoplastic nature of the substance that has replaced the normal cancellous bone and part of the marrow, and even microscopic sections from certain completely petrified portions are difficult to interpret. However, careful investigation reveals the fact that we are dealing with a diffuse invasion of existing bone by osteoid sarcoma attended by atypical calcification of enormous extent. The soft tumor without belongs to that variety of sarcoma in which a multitude of cells of different size and shape are found.

The importance of a knowledge of the peculiar growth of this tumor can be well appreciated when we glance at the picture presented by the radiogram (Fig. 24). The dense, black

Fig. 23. Calcified osteoid sarcoma of the tibia.

shadow occupying an area corresponding to the seat of the calcific process, leaves no doubt as to the nature of the lesion, and is to my mind one of the most useful points that we have in the diagnosis of the osteoid variety of sarcoma.

Reviewing the clinical history of the case we must assume that the appearance of the swelling coincided with the growth of the tumor outside of the bone and that the older lesion in the shaft gave rise to little or no symptoms other than pain. Doubtless the duration of the endosteal changes was considerable, and it was not until the soft parts became invaded that rapid growth and mutation of type occurred. How significant, then, is the sclerosis in these neoplasms, and how useful and suggestive would be the early recognition of shadows in the bone, at a time antedating the development of objective signs!

That lime deposition is not a fortuitous circumstance, but one of the marked traits of these tumors, is evidenced by its occurrence in the two cases which I shall now describe. In both the lower end of the femur was concerned.

An interesting type is presented by the case

Fig. 24. Radiogram of the specimen (taken after amputation) seen in Fig. 23; note the dense shadow in the shaft and the shadows in the calcific nucleus of the extraosteal tumor.

depicted by Fig. 25 (case 15), in which there is a most unusual combination of osteoid and fibro-sarcoma. Here, too, a central osteoid sarcoma with its origin either in the upper part of one of the condyles or in the lower part of the diaphysis had produced a sclerotic, partly calcified growth which has perforated the cortex and has occasioned an extraosteal tumor with a calcified core not unlike that seen in the previous specimen. In its intramedullary extension upward for the distance illus-

Fig. 25. (Case 15.) Osteoid and fibro-sarcoma of the femur; below and on the left, the posterior half of the specimen, the small piece to the right fitting on the cut upper margin. The two small pieces above fitted together make up most of the anterior half

trated in the schematic diagram (Fig. 51), however, a change of type to the less highly differentiated spindle and fibro-sarcoma has occurred.

It seems more than probable that the sclerosing process is the chief factor in the prevention of that resorptive and destructive quality which belong to other forms of bone sarcoma and which is conspicuous by its absence in the type just now under discussion. The preservation of the general architecture of the bone is worthy of note in the three last specimens. This, as well as some of the other characteristics is reproduced in a fourth case (16) of this series. Again we have a soft extraosteal portion (mostly behind and on the inner side of the lower end of the femur) which communicates through holes in the substantia compacta with an intramedullary growth (Fig. 28). On section of the bone the tumor appears to have its origin in the lower part of the diaphysis, at a point about ten centimeters above the intercondyloid notch where the medullary cavity is filled by an irregular mass of soft, pinkish, partly necrotic tumor tissue, only 55 millimeters in extent, measured longitudinally, and is surrounded almost completely by masses of calcified tissue that have evidently impeded the progress of the growth upwards in the medullary cavity (Fig. 29). The cortex of the shaft is greatly thickened at a point opposite to the situation of the main tumor, the new bone formation being due in all probability to subperiosteal proliferation. Where the extraosteal tumor sits on the cortex, there is either erosion or perforation of the latter. At the upper end of the tumor there is the typical wedge-shaped area of bone formation due to the reactive productive process induced by the invasion of the territory of the periosteum (Fig. 30). The soft tumor outside of the shaft is necrotic in places and contains small hæmorrhagic cavities with pure blood or bloody serum.

Fig. 26. (Case 15.) Radiogram of one-half of the tumor; areas of rarefaction and shadows of sclerosis are seen.

The value of the intramedullary densities in interpreting the shadowgraphs was brought home to us in this case, for, owing to insufficient exposure, the first plate showed no differences in the shadow of the shaft. A second skiagram reproduced in Fig. 30 indicates very well the variations due to calcification, and corresponds exactly to the picture seen in the pathological specimen (Fig. 29) the X-ray of which is seen in Figs. 31 and 32.

Let me now call attention to the group of chondro-sarcomas in which a similar sclerosis in the form of lime deposition in cartilaginous ground substance takes place. I have two such specimens to present; both would at first sight be regarded as of periosteal origin. Although our studies on this phase of the subject are not as yet concluded, we are at the present inclined to ascribe the beginning of these two growths to a site in the interior of the bone rather than in the periosteum. Case 18 afforded a beautiful example of the fusiform enlargement of a bone by sarcoma. Fig. 34 shows how the lower half of the tibia is encased in a firm mass which is pearly in section and which is apparently built in lobuli arranged perpendicular to the long axis of the bone. The central portion fuses intimately with the tibia, the marrow cavity of which is obliterated by the presence of tumor infiltrated with lime. Corresponding to the widest part of the tumor there is almost complete destruction of the normal cortex, and the petrified central tissue merges into fine lime spicules, that can be traced into the soft tumor without (Fig. 35). Above the growth of the sarcoma in the medulla has just attained the upper fourth of the bone; here, too, the tendency to calcification is manifested although the peripheral portions are still soft and cartilage-like in appearance. The detachment of the periosteum (with the typical bone deposits) is well illustrated at the

Fig. 27. (Case 15.) Radiogram of knee before operation; note the central shadow corresponding to the calcified portion of the tumor.

upper pole of the extraosteal tumor and is to be clearly seen in the photograph and skiagram of the specimen.

In another chondroid tumor a picture not unlike that found in the last specimen was exhibited. Occupying the sternal half of a rib there was a spindle-shaped tumor of soft cartilaginous consistency, surrounding the bone

Fig. 29. (Case 16.) Lower part of the femur laid open.

in the manner seen in Fig. 36 (case 19). The radiate disposition of tumor lobuli around the rib is here also a feature, and the central sclerosis and calcification, although not as conspicuous as in some of the other cases, is sufficiently marked to be a distinguishing trait of this type.

6. NON-SCLEROSING PERFORATING ENDOSTEAL

An instructive variation from the sclerosing type was found in a fifth case of osteoid sar-

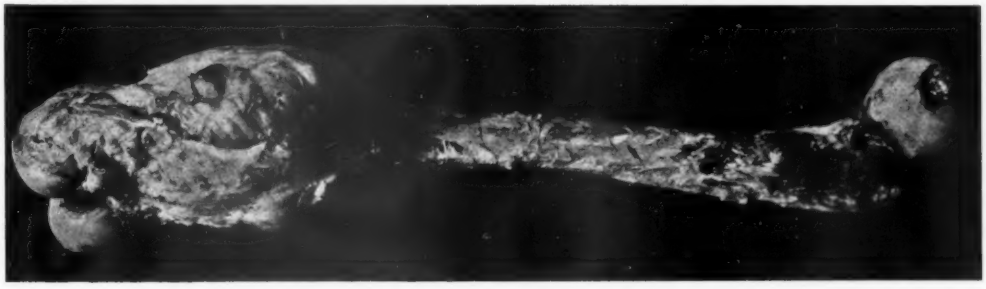

Fig. 28. (Case 16.) Osteoid sarcoma of the femur.

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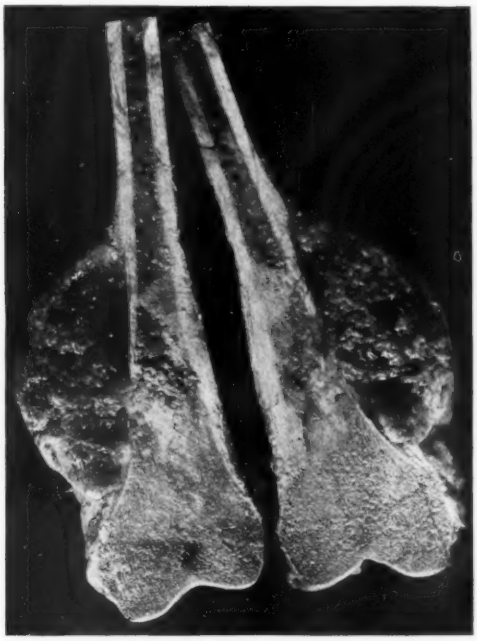

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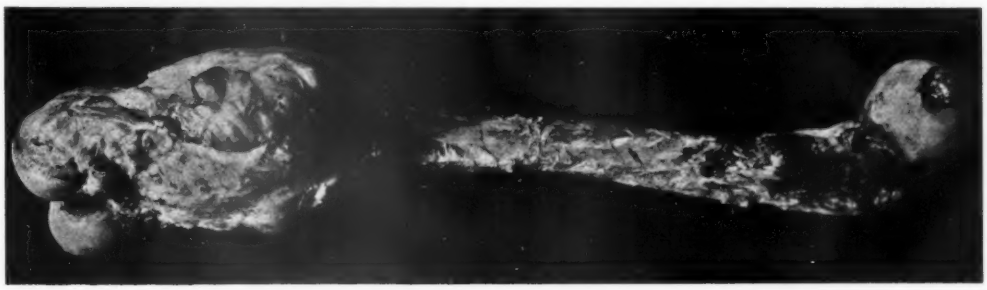


Fig. 28. (Case 16.) Osteoid sarcoma of the femur.

Fig. 30. Radiogram of thigh. Note the dense shadow due to calcification; the erosion of part of the cortex; the rarefied areas in the medulla occupied by soft tumor; and the periosteal bone formation.

coma. The neoplasm was central in its origin, and presented the remarkable condition seen in Fig. 33 (case 17). There was a central tumor which seems to have caused early perforation and have given rise to a large, soft hæmorrhagic extraosteal mass. The question as to the exact location of this growth at its inception can not be discussed in this paper. Suffice it to say that ingrowth from without is very unlike when we consider the absence of any marked degree of erosion of the cortex, and the form of the communicating channel between the tumor within and outside of the bone.

7. EXTRAOSTEAL, PERIOSTEAL, OR SUBPERIOSTEAL

Differing widely in localization, origin, mode of growth as well as histopathology, from the nineteen sarcomas studied thus far, is the large ovoid, osteo-sarcoma of the femur, the photographs of which are labelled Fig. 37 and Fig. 38 (case 20). The lower half of the bone bears a purely extraosteal tumor which has eroded a large portion of the cortical layers upon which it is placed, but which has nowhere penetrated into the medullary cavity. Somewhat less than one-half of the tumor is transformed into a stony mass of lime (Fig. 39); the lower portion is composed of a cortex of firm tissue enclosing an irregular multilocular cavernous space filled with slightly bloody serous fluid. I do not wish here to theorize regarding explanations that may be given for the absence of medullary involvement in this case, nor to state definitely whether or not the sarcoma originated in the periosteum. From the clinical standpoint it is more important to recognize these facts: That although the majority of the bone sarcomas present central foci, large extraosteal tumors may be found associated with but slight destructive changes in the bone; that there may be cystic degeneration, extensive calcification, and adequate encapsulation, with no tendency to infiltrate either bone or soft parts, so that, in spite of great size, such neoplasms must be regarded as possessing but a low grade of malignancy.

GENERAL CONSIDERATIONS

Having outlined the most striking characteristics of these twenty bone sarcomas, let us take a brief retrospect of what has been said with a view to crystallizing the many individual features into a precise conception that may be useful diagnostically, and easy of remembrance. In order to accomplish this it seems best to make tentative groups, which — because of the comparative paucity of material — must now be based on gross similarities of development plus resemblances in

Fig. 31.

Fig. 32.

Figs. 31 and 32. (Case 16.) Skiagrams of the two halves of an osteoid sarcoma of femur.

cellular composition, rather than on one or the other of these alone. Doubtless when more specimens will have been studied,[1] a more definite and rational mode of classification will be made possible. The grouping that I shall adopt must be regarded merely as one of temporary convenience of some mnemonic and clinical value.

It has been the custom to classify sarcomas of bone either according to their histopathology or according to their origin in bone or periosteum. As for the former method, this has its merits only when the points referred to early in the paper are observed. Thus it would be quite impossible to find a place for an osteoid sarcoma in which there are areas of almost pure spindle cells, if we did not remember that such areas are but expressions of non-

[1] Since the reading of this paper we have begun the study of a second series of bone sarcomas.

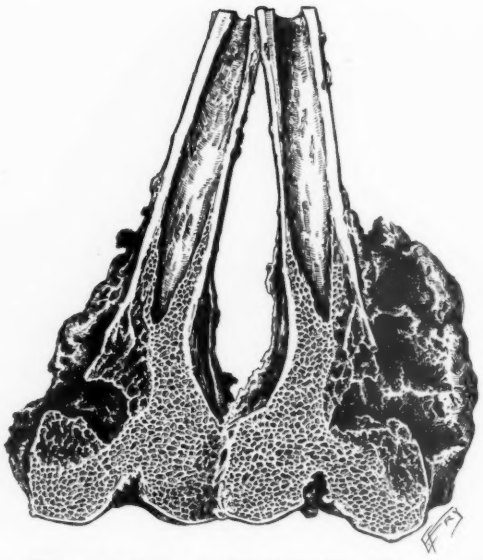


Fig. 33. (Case 17). Non-sclerosing, soft type of osteoid sarcoma.

differentiation in that particular part, and do not lend essential characteristics to the growth under consideration. Similarly a rapidly growing mixed-celled extraosteal growth is not the significant portion of a sclerosing calcifying osteoid tumor, and must be disregarded, if the histopathological arrangement be employed. Although of value, in the investigation of the evolution of the types encountered, this method has its drawbacks for our purposes. Thus the chondroid sarcomas of the tibia and rib (Figs. 34, 35, 36) are more closely related, in their manner of growth, to the osteoid tumors (Figs. 23, 24, 25, etc.) than to their histologic congeners, the chondro-sarcomas seen in Figs. 6, 7, and 8; for the regressive process, extensive calcification, as distinguishing property of the former, is of more importance in determining the nature of the gross product, than is the predominating type of cell or intercellular substance. Further the spindle-celled or fibrosarcoma of the femur (Figs. 10, 11) presents quite a variation in the manner of its progress, from other spindle-celled sarcomas that I have seen. It has appeared to me best, therefore, for the present at least, to look especially for similarities and difference in the gross architectural features and to attempt a grouping in which this shall receive prime consideration.

As for the division into periosteal and myelogenous varieties, this need not be discussed here, since I have already spoken of the uncertainty of our knowledge on this point.

What then are some of the peculiarities that we must observe, and which of these may be of service to us in comprehending a subject that at first sight presents such a maze of intricacies? Let us succinctly state the important characteristics of growth. One or more of these belong to each one of the tumors examined.

1. The origin of the tumors is usually in the bone itself or in the medulla; it is rarely in the periosteum.[1]

2. The tumor forms a focus which evidences a certain method of advance.

3. The advance is rapid, highly destructive, and perforation occurs early; total disintegration of the bone may be an early issue.

4. The process of extension tends to confine itself within the bone, especially in the medullary cavity; there is no expansion of bone.

5. The central focus lies in sclerotic bone (sclerosing osteitis, chronic osteoperiostitis); it develops rapidly on finding an outlet into the soft parts.

6. The growth is slow; it is accompanied by extensive calcification; there is no expansion of the bone; perforation occurs late.

7. The tendency to calcification is a factor in the preservation of the general bone outlines, and deters the progress of the neoplasm; it may occur both in the intra- and extraosteal portions.

8. There is expansion of the extremity of a bone with extensive destruction.

9. There is expansion of the extremity by cyst formation.

10. There is expansion of the shaft by tumor.

11. There is penetration of the bone with the development of extraosteal tumors and characteristic subperiosteal osseous deposits.

12. The extraosteal masses may or may not differ in their histopathology from the primary neoplasm; their proliferative powers

[1] The periosteal origin is still a question; only one tumor case might be considered as belonging here.

Fig. 34.

Fig. 35.

Fig. 34. (Case 18.) Chondro-sarcoma of the tibia.
Fig. 35. (Case 18.) Skiagraph of the specimen showing sclerosis and periosteal bone formation.

are far in excess of those of the endosteal growths.

13. The tumor apparently lies wholly outside of the bone.

From a consideration of the foregoing, we may assign our tumors a place under one of the following heads:

TENTATIVE GROUPING OF THE TWENTY TUMORS

1. Expansive (of the extremity)
   - *a.* benign cystic (cystic myxosarcoma)
   - *b.* slightly malignant (giant celled)
   - *c.* malignant (osteoblastosarcoma)[1]

[1] Of the immature cellular type.

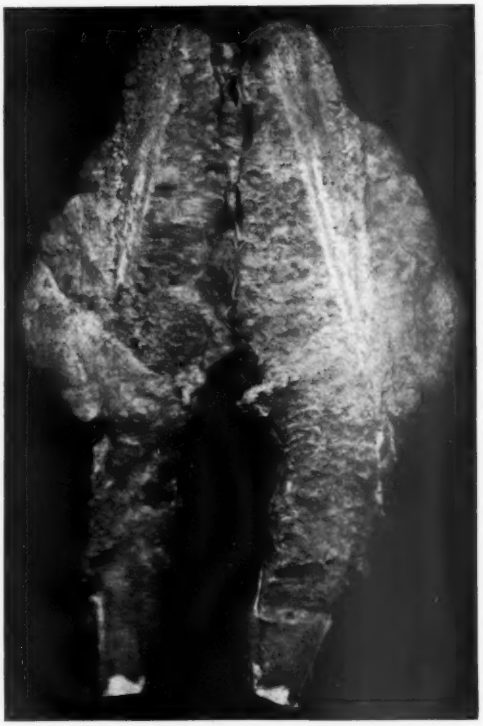


Fig. 36. (Case 19.) Chondro-sarcoma of rib.

2. Expansive (of the shaft) (chondrosarcoma)
3. Diffusely infiltrating, (non-expansive) endosteal (spindle fibro, round)
4. Destructive (dissolutive) (non-expansive) (round, spindle)
5. Sclerosing (calcifying) endosteal — *a.* (osteoid) *b.* (chondroid)
6. Non-sclerosing perforative endosteal — (soft, osteoid)
7. Primary extraosteal (periosteal or subperiosteal) — (osteosarcoma).

Perhaps the schematic diagrams, here inserted, may facilitate the recognition of the groups recorded in this table.

1. *The expansive tumors.* Figure 40 shows well the expanding influence of a giant-celled sarcoma of the tibia; the shaded triangle represents new periosteal bone proliferation. The cystic variety or benign type is seen in Fig. 41. The effect of the malignant variety is similar except that it causes earlier perforation with tumor infiltration outside of the bone.

2. *Expansive tumors of the shaft.* (Figs. 42 and 43.) Both of my specimens were of the cartilaginous variety. The question as to the presence of a primary endosteal chondroma has not as yet been definitely answered by my studies. The preservation of the thickness of the substantia compacta in the chondro-sarcoma of the femur (Fig. 43), in spite of the fusiform dilatation of the bony walls, seems to speak in favor of the assumption that a pre-existing chondroma, which had developed during the period of adolescence, may have been the primary lesion. Further studies of this specimen are being made with a view to solving this point.

3. *Diffuse, infiltrating, endosteal* (non-expansive) tumors comprise a varied series in which the external manifestations of disturbance in the bone may appear very late. Three of the four tumors of this class are diagramatically represented in Figs. 44, 45, and 46. The fibro-sarcoma of the femur (Fig.44) with the absence of bone dilatation, in spite of the extent of endosteal invasion, and the pathological fracture, are sufficiently characteristic phenomena. In the endosteal round-celled sarcomas of the humerus (Fig. 46) the expansion is more apparent than real. The bone cortex was practically destroyed and the enlargement of the bony contour is to be accounted for in the main by periosteal bone formation, due in all probability to minute perforations. The combination of sclerosing osteitis and productive periostitis with a central diffusely infiltrating round-celled sarcoma of the tibia is illustrated by Fig. 45.

4. *Destructive, dissolutive, non-expansive sarcomas* belong to the most malignant varieties. Two of the three neoplasms studied are represented in Figs. 47 and 48. Early in the course of development there may be reactive endosteal bone proliferation so that the medullary cavity is filled with tumor and bone (Fig. 46). This is soon associated with penetration of the cortex, and detachment of the periosteum with its sequelæ. Later a picture such as seen in Fig. 48 is produced, a large soft tumor in which there are scant remnants of bone.

Fig. 37. (Case 20.) Osteo-sarcoma of femur; posterior view.

5. *Sclerosing* (calcifying) *endosteal*. The four osteoid sarcomas (three of the femur, one of the tibia) belong here — Figures 49, 50, 51, and 52 show the areas of calcification as well as the soft or partly calcified extraosteal tumors

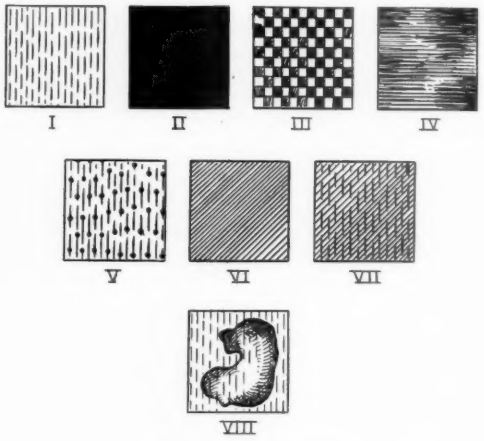
Fig. 38. (Case 20.) Osteo-sarcoma of femur; longitudinal section.

Fig. 39. (Case 20). Skiagraph of thigh; upper calcified portion of tumor gives dense shadow.

that may develop. Chondroid tumors (Figs. 53 and 54) may also exhibit similar characteristics for two examples are of the type formerly considered as periosteal tumors; they cause fusiform enlargement of the bone.

6. *Non-sclerosing perforative endosteal:* A soft, central, small osteoid tumor that must be regarded as of more rapid growth than those of the last series, is shown in Fig. 55.

7. *Primary extraosteal* (periosteal or subperiosteal). There is but one specimen of this variety to report (Fig. 56) a large osteosarcoma (Figs. 37, 38, 39, 56) of the femur.



Key to schematic drawing:

I. Soft tumor.
II. Calcified areas.
III. Tumor growing in bone.
IV. Calcification in extraosteal tumor.
V. Osteoma.
VI. Periosteal bone formation.
VII. Tumor invading periosteal bone.
VIII. Cavities in tumor.

Figs. 40–56. Schematic drawings illustrating groups of bone sarcoma.

Figs. 40, 41. Expansive.

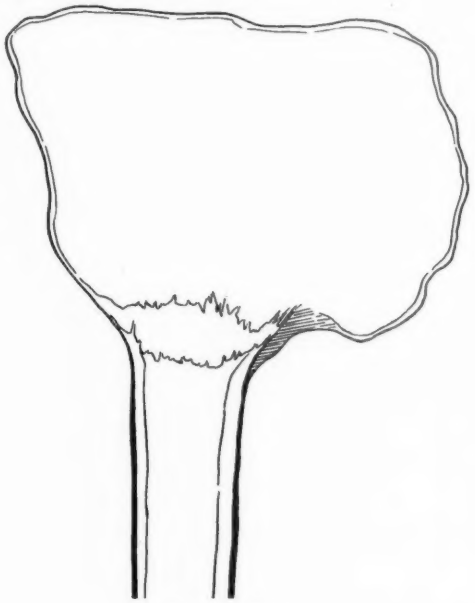


Fig. 40. Case 1.

PATHOLOGY

It would be premature to draw far-reaching deductions and to see marked evidences of interrelationship between the microscopic features of growth, as seen in the specimens, and the cellular morphology of the tumors from a study of but twenty specimens. Nor shall it be my purpose to describe the minutiæ of the findings. I shall content myself with pointing out a few observations that a general survey of the material at hand may warrant.

Nowhere in the pathology of tumors are the developmental types better represented than in the sarcomas of bone. Thus the evolution of the mature forms from the lowest purely cellular forms, the reversion to young types in the metastases, the association of closely related tissue types in the same tumor, all this and many more instructive features are encountered. Although we can not assert with positiveness that the malignancy of the bone sarcomas bears a definite ratio to the degree of immaturity, still the rapid growth of the very cellular, young type of extraosteal

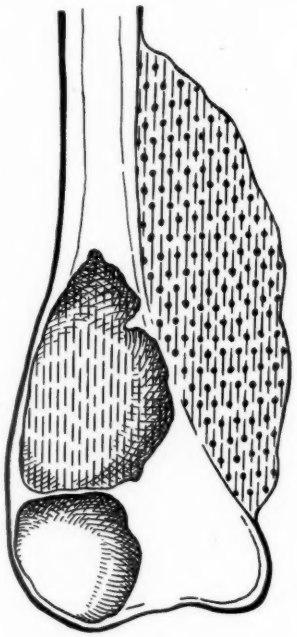


Fig. 41. Case 2.

Figs. 42, 43. Expansive — shaft.

Fig. 42. Case 4.

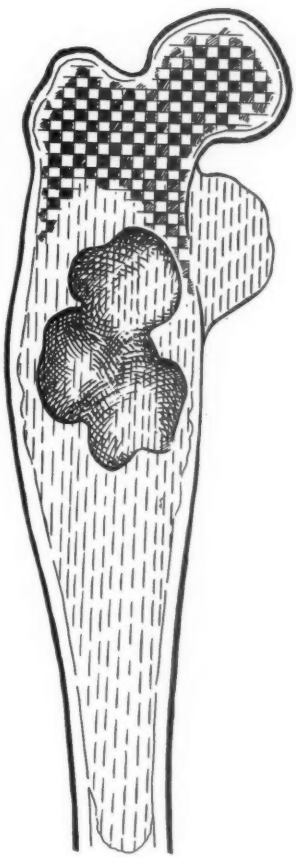


Fig. 43. Case 5.

tumor, as opposed to the slow development of the primary focus would point to the truth of the general statement. The destructive nature of some of the round- and spindle-celled (unripe) neoplasms contrasts strikingly with the less deforming growth of the osteoid and chondroid forms in which, too, calcification is a factor in inhibiting bone dissolution. However, it must be remembered that even the matured forms in which a specific ground substance is developed, may at times revert in places to highly cellular types, so that a sudden addition of malignancy, as it were, is acquired.

Our own material includes the following: Giant, round, spindle-celled, chondro, chondroid osteo-, osteoid, myxo-, and osteoblastosarcoma.[1]

NOTES ON DIAGNOSIS

Not wishing to deviate from my intention to confine myself to those inferences that the study of my own specimens may permit, I shall omit all the well-known diagnostic points and summarize a few facts that have already been educed and alluded to elsewhere in my paper.

1. To the expansive type belongs the phenomenon of "ping-pong ball"[2] or "egg-shell" crackle.

2. Bone expansion is a feature of a minority of the bone sarcomas examined.

3. Bone expansion occurs in the shaft as well as in the extremities of the long bones.

4. We should recognize the diffuse infiltrative endosteal variety as one which may remain latent until pathological fracture occurs; and should remember that normal bone contour is not incompatible with the presence of intramedullary growths.

5. Certain destructive types, causing fusiform enlargement of the part, and very frequently involving the upper end of the fibula, are malignant tumors, that soon penetrate into the soft parts.

6. A combination of chronic osteoperiostitis with central sarcoma may occur.

7. Calcification in the osteoid and chondroid tumors is a feature which may be of great value in diagnosis.

[1] Further studies of the histopathology of bone sarcomas are being made by Miss A. Oppenheimer and myself and will be reported at some future time.

[2] I think that Bloodgood first used this term.

Figs. 44, 45,[1] 46. Diffuse infiltrating.

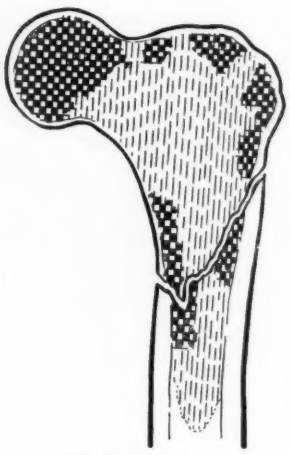


Fig. 46. Case 9.

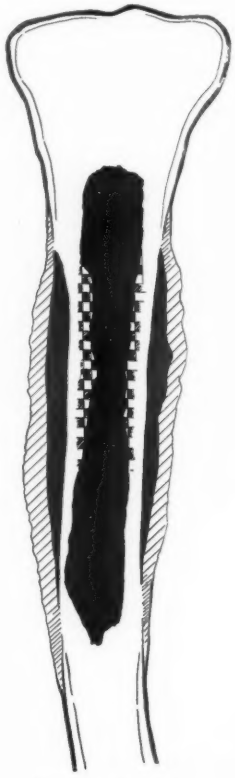


Fig. 45. Case 8.

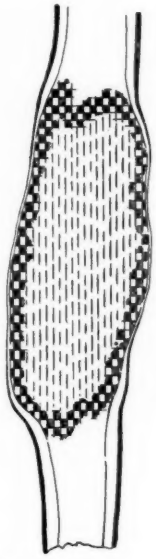


Fig. 44. Case 6.

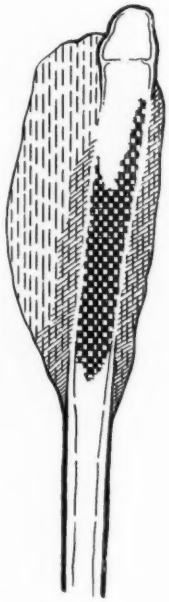


Fig. 47. Case 11.

Figs. 47, 48. Destructive.

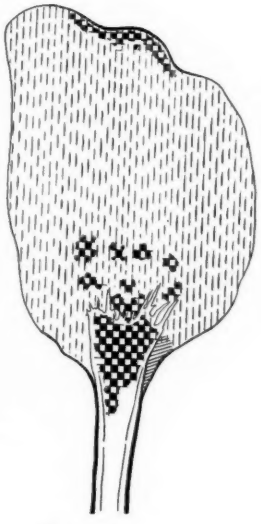


Fig. 48. Case 10.

[1] The dense black areas are inflammatory sclerosis; sclerosing osteitis.

Figs. 49, 50, 51, 52. Sclerosing, endosteal (*a*) osteoid.

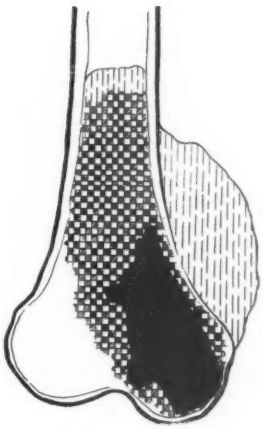


Fig. 49. Case 13.

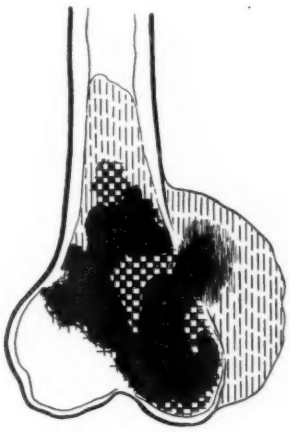


Fig. 51. Case 15.

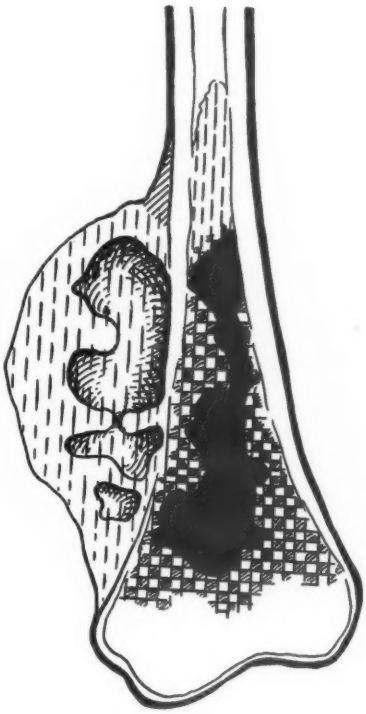


Fig. 50. Case 10.

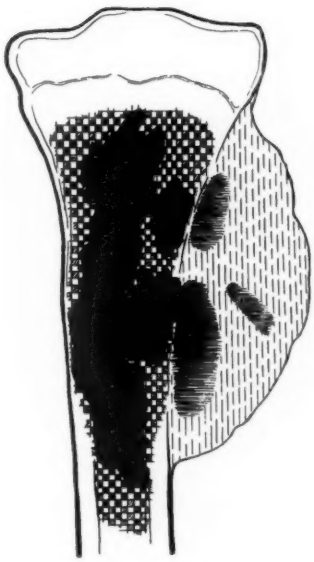


Fig. 52. Case 14.

Figs. 53, 54. Sclerosing, endosteal (*b*) chondroid.

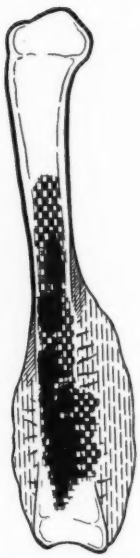


Fig. 53. Case 18.

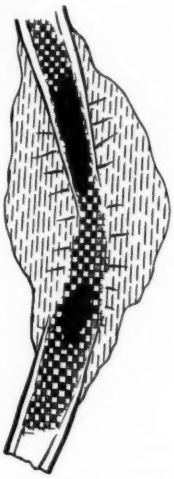


Fig. 54. Case 19.

Fig. 56.. Primary extraosteal.

Fig. 55. Non-sclerosing perforative endosteal.

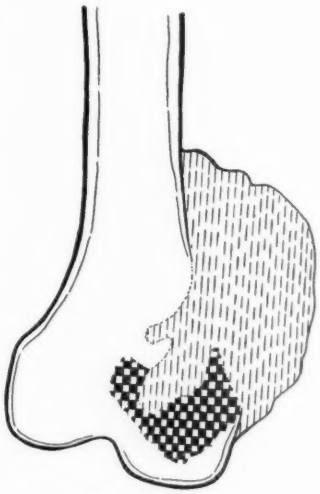


Fig. 55. Case 17.

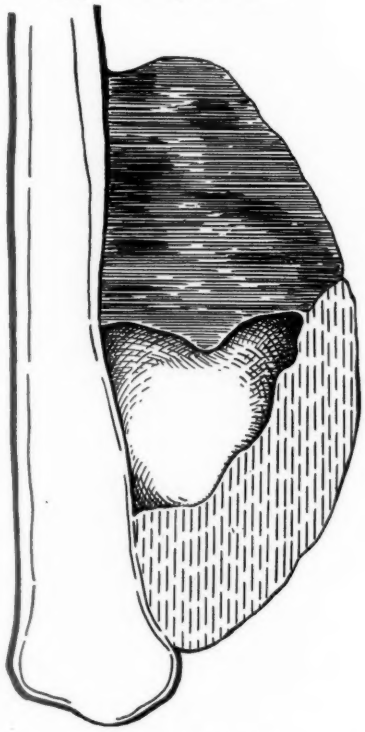


Fig. 56. Case 20.

8. Periosteal bone production is also to be utilized in diagnosis.

9. Skiagraphs are of great importance in the recognition of these tumors. We should look for the characteristic periosteal bone deposition and especially for dense shadows in the diaphyses as well as epiphyses, with a view to diagnosticating the sclerosing type of osteoid and chondroid sarcoma. The extensive calcification and the slow endosteal progress exhibited by certain types suggests that early diagnosis may be possible. To discover the presence of endosteal lesions before the more malignant extraosteal masses have developed should be a desideratum. Fine radiographic bone detail is essential for an adequate interpretation of the pathologic changes.

10. A large tumor in the soft parts is no reliable measure of the extent of the bone destruction or the size of central focus if such there be. Large tumors outside of the bone may be associated with a very slight lesion in the bone.

I am indebted to Dr. F. S. Mandlebaum, director of the Pathological Laboratory, Mount Sinai Hospital, for the photomicrographs, to Dr. Jaches for some of the X-ray illustrations, and to Miss Adèle Oppenheimer for much assistance in the course of this study.

SOME DATA ACQUIRED WITH THE AID OF THE URETERAL CATHETER

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With the development of cystoscopic technique the various possibilities of the ureteral catheter are being revealed. Experience has demonstrated that there is little or no danger of renal infection through cystoscopic manipulation, provided that reasonable precautions are taken. Of the thousands of ureteral catheterizations made at St. Mary's Hospital, we have no record of a single infection.

We have found the various data acquired through the use of the ureteral catheter to be of much value in the diagnosis of renal conditions. Although the ureteral catheter was originally intended for the segregation of the separate urines, we have learned to recognize its value in acquiring further information concerning conditions present. It is with these latter data that this paper will deal.

The length of catheter that can be inserted into a ureter varies widely, depending upon, (1) size of catheter, (2) flexibility of catheter, (3) rigidity of ureter and renopelvic walls, (4) size of renopelvis, and (5) actual obstruction to the catheter. If a flexible catheter, size 5 to 6 Fr is used, the normal limits will be found to vary from 28 to 45 cm. of catheter. In 1,000 normal ureters I have found the average length of catheter inserted to be 34 cm. The usual limits are from 30 to 40 cm. If the length is found to be between 27 to 30 cm. one must suspect the possibility of pelvic encroachment. If less than 27 cm. of catheter can be inserted, an obstruction must be inferred.

The fact that more or less difficulty is encountered in passing the catheter in about a third of the ureters I catheterize has led me to a closer study of such obstructions.

It is possible for the ureteral catheter to meet with obstruction at any part of the ureter: meatus, bladder wall, free ureter, or at the ureteropelvic juncture. The fact that the ureteral catheter is obstructed in its course does not necessarily mean that a stricture or a stone is blocking the ureter. In fact, it may not be a surgical obstruction at all, as has been frequently found on subsequent surgical exploration.

Obstructions to the ureteral catheter may, therefore, well be regarded in two groups, *surgical* and *non-surgical*.

Non-surgical obstructions include those

caused (1), by physiological conditions, (2), by non-surgical inflammatory conditions in the urinary tract.

One is frequently surprised to find that in otherwise normal individuals the ureteral catheter will meet with definite obstruction in its passage. This may be encountered in any part of the ureter, but only in exceptional cases, above the angle where the ureter leaves the bladder.

Obstruction is frequently found in hypersensitive individuals. It is especially common in the male in whom the already hypersensitive urethra and bladder are thrown into a spasm by the instrumentation. The spasmodic condition of the vesical musculature may be so intense as to prevent the passage of the catheter after it has entered the meatus. More frequently the impassible obstruction is met at the angle where the ureter leaves the bladder wall, which is probably rendered acute by the contracted vesical musculature. The findings are particularly confusing should the clinical symptoms be suggestive of possible surgical ureteral obstruction, or if the radiograph shows a *possible* stone in the ureter. That obstructions are due to spasmodic contracture of the vesical ureteral musculature is further proven by the fact (1), that such obstructions can often be passed by injecting fluid through the catheter to distend the ureter beyond, (2), on surgical exploration the ureter is found normal.

Particularly in inflammatory conditions do we meet with such obstructions. In an irritable cystitis it is quite common to meet with more or less difficulty in passing the catheter. If chronic pyelitis is also present, the obstruction may be met with at any distance up the ureter. Whether such obstruction well above the bladder may be due to ureteral spasmodic contracture, or the actual inflammatory changes of the ureter, would be difficult to say.

In considering surgical obstructions, we find that those caused by stone, traumatic stricture, and tuberculosis are common to all parts of the ureter. Whereas stone is the most frequent cause of obstruction, yet it may not, as we know, cause any hindrance at all. The percentage of stones which will permit the ureteral catheter to pass them unnoticed, must be a variable one depending upon the operator, catheter used, size and shape of stone, ureteral dilatation, etc. The obstruction being palpable, it is frequently possible to distinguish a stone by detecting the uneven surface as the catheter slides by, or by a peculiar clinging to the catheter on its withdrawal. Of 40 cases of stone in the ureter which came under our observation during the last two years, 80 per cent were felt in passing the catheter. Of 30 cases of stone in the pelvis, 70 per cent were palpated. For various reasons, such as a very adipose abdomen, small soft stones, stones imbedded in fat, stones obscured by the iliac artery, the radiograph may show an indistinct shadow or none at all. On the other hand, phleboliths, glands, calcareous deposits, etc., may cast shadows similar to stones. Therefore, every case with symptoms strongly suggestive of renal or ureteral calculus in which the radiograph is indefinite, should be checked up by the ureteral catheter.

Another rather common form of obstruction to the catheter is that caused by tuberculous ulceration of the ureter. From the ulcerative nature of the lesion, it is quite evident that the ureter, which is so frequently involved, might have cicatricial and inflammatory constrictions. As a rule, there are several obstructions palpable to a greater or less degree. They are not, as a rule, at the usual places of narrowing. More often they may occur along the canal of the free ureter and may give way to a little pressure if a small catheter is used. At times the obstruction is situated just beyond a crater-like golf-hole meatus, and may be so low that the catheter will not penetrate far enough to collect any urine.

Obstructions common to the meatus, other than those common to the entire ureter, may be caused by cystic dilatation, bladder tumors, and congenital narrowing.

Cystic dilatation of the lower ureter may be of various degrees, so great as to partially fill the bladder. When large it may be impossible to enter with the ureteral catheter. In one case which came under my observation, the large sac was squeezed down by the cystocope until the meatus was located by the spurting urine. The ureter was entered with some difficulty with a fine pointed catheter. A distinct grating was palpable just above, which,

on operation, was found to be due to numerous small stones, and on pelvic distention, a hydronephrosis was determined.

The lax condition of the ureter in hydronephrosis may permit enough sagging of the meatus so that it appears cystic, and difficulty may be encountered in entering the ureter. The obstruction encountered by the ureteral catheter when the meatus is entered, is not necessarily due to stone, but may be due to inability of the catheter to find the ureter lumen.

Bladder tumors frequently obstruct the meatus. When the tumor is large and is situated near the meatus, it may sometimes be impossible to find the meatus at all. A small bladder tumor may be situated near the meatus, leaving the opening visible, and still be the cause of symptoms of renal obstruction. This was well illustrated in a patient who came under my observation complaining of frequent renal colics. Cystoscopic examination revealed a small papilloma near the meatus. A ureteral catheter met obstruction just within the opening, which was passed after a little pressure, and a 6.0 c.c. hydronephrosis was demonstrated above. On removal of the growth the symptoms ceased. Evidently the tumor had extended into the tissues about the ureter, and with accompanying inflammatory changes had occasionally occluded the lumen, giving rise to renal colic.

Obstruction at the pelvis of the kidney presents another group of possibilities. If the ureteral catheter meets with an obstruction at from 20 to 27 cm. from the meatus, we must infer an obstruction about the ureteropelvic juncture. Among the possible causes for such an obstruction, I have found: ureteropelvic stone, dead kidneys with atrophied or fatty pelvis, small soft kidney with atrophied pelvis, anomalous blood-vessels constricting the upper ureter, atresia of the upper ureter without evident etiological factors, deformities of the pelvis resulting from encroaching tumors. The nature of an impassible obstruction at the pelvis is of course impossible to ascertain by means of the ureteral catheter alone. A ureteropelvic stone can usually be determined by the X-ray. Dead kidneys, especially those with discharging sinuses, often have but a shell of secretory substance remaining in the mass of inflammatory renal tissue. The pelvis will then either be destroyed or remain as a small pocket and obstruct the catheter at a length of from 23 to 27 cm. The dead kidney may undergo fatty degeneration and the pelvis be filled with masses of fat, as occurs in cases of long standing processes. A pelvic stone may be the original cause, and when imbedded in the mass of fat, may not be revealed by the X-ray.

Renal tumors encroaching upon the pelvis, or stones free within the pelvis, may offer a distinct obstruction just after the catheter enters the pelvis, and may not permit more than 27 to 28 cm. of catheter to be inserted.

Constriction of the upper ureter resulting from congenital anomalies, may, with a few exceptions, be passed with a little pressure. The obstruction may even be so slight as to be scarcely felt. As the catheter glides by, a round smooth obstruction is usually made out, particularly if the condition is due to anomalous vessels. Such obstructions in the upper ureter are met at shorter lengths than those at the pelvis itself, usually from 20 to 23 cm. The obstruction once passed, a variable amount of catheter can be coiled up in the renal pelvis. If the obstruction is a stone, less catheter can be coiled up than if an anomalous blood-vessel was the cause of obstruction. The stone, as a rule, causes a smaller sac and partially fills the sac with its volume. The dilatation above a constricting blood-vessel or other congenital anomaly, will permit the entire length of catheter to be inserted without palpable friction. One frequently finds a normal pelvis and ureter which will permit as much as 45 cm. and occasionally 50 cm. to be inserted. On further examination these will prove to have little or no dilatation. Furthermore, some friction is always noticed even if the catheter is soft. It is possible that in such a lax pelvis the catheter may double back on itself and re-enter the upper ureter. Although 50 cm. or more of catheter inserted is indicative of a pelvis dilatation, we have still more definite means of ascertaining the size of the pelvis.

The nerve supply of the renal pelvis is peculiar in that, — (1), it probably gives the pelvis little or no active motive force. (2), The pelvis is but mildly sensible to a stimulus,

such as a ureteral catheter, or a small amount of fluid. (3) If the pelvis is irritated it will not alone react violently itself, but will also reflexly stimulate the nervous mechanism of the entire urinary tract, and the subject will suffer what is known as renal colic. Such colic can be artificially produced by over distending the renal pelvis. We know that the renal pelvis will usually contain from 5 to 15 c.c. of fluid. From my records of about 1,000 pelvic distentions, the normal average capacity of the pelvis was found to be 11 c.c. This capacity will be found to vary in the following conditions: (1) In over irritable conditions it will hold less than 5 c.c. (2) A certain group of pelves will contain as much as 30 or even 40 c.c. of fluid without colic being produced. (3) Pelves which contain more than 40 c.c. of fluid before colic is caused, are abnormally dilated and may be considered surgical.

Group 1. There are a number of conditions which will cause the pelvis to react after 2 or 3 c.c. of fluid have been injected. Frequently the hyperirritability is caused by stone in the pelvis. It is nearly always present if the stone does not interfere with the urinary drainage and cause pelvis dilatation. It frequently occurs in chronic pyelitis. If the pelvis is encroached upon by renal tumors, as with hypernephromata or cystic degeneration, colic is occasionally produced after a few c.c. are injected.

Group 2. Pelves permitting the injection of 20 to 30 c.c. of fluid before colic is produced, other pathological conditions being excluded, do not require surgical intervention *per se*. Such patients may present themselves with a clinical history warranting surgical exploration, which procedure may reveal no dilatation nor any cause for the symptoms. The findings occur usually in individuals with other marked neurotic symptoms. The diminished sensibility may be explained by an hysterical anæsthesia similar to that frequently observed in the pharynx or cornea.

However, a moderate dilatation of the pelvis may exist with a number of surgical conditions. The dilatation caused by a stone partially obstructing urinary drainage from the pelvis, is not usually an extreme one. The pelvis may be partially filled by the stone itself and still show dilatation. Our records show hypernephromata with secondary degeneration and various forms of pyonephrosis, with pelvic dilatation varying from 20 to 40 c.c.

Group 3. A surgical dilatation of the pelvis may be caused by an obstruction at any point in the urinary tract below the pelvis. Urethra and vesical obstruction excluded, there remains still a long list of ureteral obstructions. Operation records show that ureteral obstructions are due to congenital anomalies, stone, cicatricial changes, and extraureteric pressure, in the order of their frequency. The obstruction having been met and passed, the first evidence of dilatation above is observed by a steady rapid flow of a light colored urine, without peristaltic hesitation. Enough urine is allowed to flow to at least partially empty the pelvis. The pelvis is then distended with fluid until pain is created. It has been our experience that unless a pelvis holds 40 c.c. before colic is produced, it will not show a dilatation on exploration. Frequently the pelvis will hold as much as 200 c.c. without discomfort being caused. If 150 c.c. can be injected, but little secreting substance remains in the kidney and a nephrectomy is indicated.

TECHNIQUE

The syringe we use to inject the distending solution with is an ordinary Murphy aspirating syringe with a capacity of 12 c.c., to which a blunt needle is attached. A graduated cylinder might be employed and the distending solution allowed to run in by gravity. The injected fluid is a two per cent boric acid solution, warmed and colored with methylene blue. The solution is colored to determine whether any of the injected fluid returns alongside the catheter. If a return flow is visible, the value of the findings is negated, for it would be impossible to determine even relatively the amount of fluid remaining in the pelvis. There was a return flow in but one of the cases of hydronephrosis that came under my observation, and that was because the catheter met an impassible obstruction.

It is quite logical that the fluid should remain in the dilated sac, and not run back after a few c.c. are injected. For this reason no sur-

gical dilatation exists if a return flow occurs before 40 c.c. are injected even though no colic is produced.

In distending the pelvis, care must be taken not to inject any more fluid than is necessary to cause pain. Unless the fluid is injected slowly and immediately stopped on producing renal pain, a severe colic will follow, frequently prostrating the patient for several days.

It has been claimed by several observers, that the nature and location of the pain created, is of value in differentiation from the pain the patient usually complains of. However, we have not found the subjective differentiation of much value.

RÉSUMÉ

1. Obstructions to the ureteral catheter are due to a great variety of causes.

2. They can, however, usually be identified and are of much corroborative value in renal and ureteral diagnosis.

3. The length of catheter that can be inserted into the normal ureter and pelvis varies from 28 to 45 cm. As a rule it is from 30 to 40 cm. If the obstruction is felt at 20 to 25 cm. an obstruction in the upper ureter is to be inferred. If only from 25 to 27 cm. can be inserted, the obstruction is at the pelvis juncture. If from 27 to 29 cm. are passed, some obstruction within the pelvis is usually present.

4. Non-surgical obstructions are frequently met with in the vesical ureter. They are probably caused by (a), a spasmodic constriction of an irritated or inflamed vesical musculature, (b), the angle at which the ureter leaves the bladder wall is rendered more acute by the contracted bladder muscle.

5. A stone in the ureter can be felt with the ureteral catheter in about 80 per cent of cases.

6. Stone in the pelvis can be felt with the catheter in about 70 per cent of cases.

7. In most cases of advanced renal tuberculosis, obstruction is met with in the ureter — frequently multiple.

8. If 50 or more cm. of catheter can be inserted without friction, pelvic dilatation usually exists.

9. A smooth moderate obstruction at from 20 to 25 cm. with evidence of dilatation above, is often caused by obstructing anomalous blood vessels.

10. The capacity of the renal pelvis can be approximately ascertained by distending it with a measured amount of fluid. If the capacity is more than 40 c.c. it is surgical. If more than 150 c.c. a nephrectomy is indicated. A return flow before 40 c.c. are injected negates the value of the findings.

11. Differentiation of the pain caused by over distention, from the symptomatic pain, is not practical.

ANÆSTHETICS IN HOSPITALS AND PRIVATE PRACTICE[1]

By JAMES TAYLOE GWATHMEY, M. D., New York City

WHEN Long and Morton gave to the world ether, and Colton and Jackson nitrous oxide gas, and Andrews, of Chicago, a few years later, showed that oxygen when combined with this latter gas produced a non-asphyxial form of anæsthesia, the American profession seemed to think that they had contributed their quota of knowledge and that further research in this particular field was unnecessary. Dr. John Snow and later J. C. Clover, and at the present time Frederick Hewitt of England, took up the experimental and clinical features of anæsthesia, studied carefully the physiological effects of anæsthesic drugs, and placed the giving of anæsthetics upon a scientific basis. We are indebted principally to England for all that we know of the accurate dosage of anæsthetics. England has long since recognized the giving of anæsthetics as a profession in itself, and this accounts for the practical and scientific work in that country.

[1] Read before the American Gynecological Association, at the Waldorf Astoria Hotel, New York, April 20, 1909.

Only a few years ago Mr. Thomas Bennett of New York City established himself as the first American practicing anæsthetics exclusively. The administration of anæsthetics as a specialty is recognized in only a few of the larger cities of America to-day. So intense has the interest been in surgery that anæsthetics have been used only as a means to an end, and this fully explains the attitude of the profession on this subject in America at the present time.

The advancement in anæsthesia in England has been rapid. Facts that are well known to the professional anæsthetist in Europe and recognized as facts have been completely overlooked by the profession here. This will continue until the profession as a whole assumes an entirely different attitude than that which they hold to-day. A curettage performed by a trained nurse is by statute a crime, punishable by imprisonment. There is less reason why a nurse, or any other person without training, should give an anæsthetic than attempt a curettage. If a curettage, performed by any one except a licensed graduate of medicine is a crime, so also is the administration of anæsthetics. Anæsthetics administered by a trained nurse means some one anæsthetic and some one method, usually the drop method of ether. It also means the abandoning of all hope of progress and development along this line.

The present system of administration of anæsthetics by hospital internes is irrational and most unjust to recent graduates, to say nothing of the patient. If I have been rightly informed, the English system is almost perfect and can be easily established in any community, large or small. It also gives charity patients the same service as private ones, and settles forever all problems connected with this subject. Briefly outlined it is as follows:

One, two, or three anæsthetists are attached to as many hospitals, thus making it possible to relieve one another according to their private engagements. These specialists give most of the anæsthetics, the internes giving only a certain predetermined number, and then under the personal supervision of the visiting anæsthetist. The anæsthetist sends his bills direct to the patient, thus establishing his identity and independence. Under this system the anæsthetist can stand as high in the profession and make as good a living as other physicians. There would not be many gynecologists if the general practitioners who referred patients to them also paid them for their services. There would not be many trained nurses at twenty-five dollars a week if they were paid by the physician instead of by the patient. Handling another man's money is both theoretically and practically wrong. When the anæsthetist is paid by the surgeon it always means the minimum fee.

In the light of recent discoveries no surgeon is justified in adopting any one anæsthetic or method of administration exclusively. There are four general anæsthetics in use and three methods of administration: the closed or breathing-through valves; the semi-closed or re-breathing; the open or drop, or preferably, the vapor method.

The vapor method is an open method with the anæsthetic heated to the temperature of the blood, and the percentage as given, is known. The signs of surgical anæsthesia differ with the anæsthetic and method used; they are still further modified by the preliminary medication of morphine or a whiskey and saline enema, or any other preliminary medication.

Nitrous oxide gas. Nitrous oxide gas and nitrogen is the only non-poisonous anæsthetic available to-day. Unfortunately it is considered by men of large experience to be adapted to only about 30 per cent of the surgical cases that come to us — namely, weak, anæmic men and middle-aged women. These patients should have the benefit of this anæsthetic whenever possible. Nitrous oxide gas and oxygen supplemented by ether, can be used in at least 60 per cent of all cases. Nitrous oxide gas and oxygen can and should be used as a preliminary to ether in at least 80 per cent of all surgical cases. Nitrous oxide gas and oxygen should not be given, even as a preliminary, to the athlete, the alcoholic, the obese, and those with small or obstructed air passages.

Ether. Ether should usually be preceded by either nitrous oxide gas and oxygen, or nitrous oxide gas by the closed or semi-closed method, or ethyl chloride by the drop method. Administered in this way the ether is reduced in amount by at least 30 per cent. The patient is plunged into deep surgical anæsthesia in

three minutes, without smelling or tasting the ether, and consequently without struggling and without any unpleasantness whatever. If now, at the proper time, you change to chloroform, or, preferably, warm chloroform and oxygen, every requirement of the surgeon is fulfilled — that is, absolute relaxation, quiet breathing, and a full, regular pulse. As the operation is about completed, a saline enema should be given the patient, preferably in the Trendelenburg position. Anæsthetized in this way, with proper preliminary and after-treatment, there will be no nausea or vomiting, nor any complication of heart, kidneys, or lungs.

Chloroform. Over 90 per cent of the fatalities with chloroform have occurred during the first fifteen minutes of administration, and a large majority of these patients have been in robust health, with absolutely no pathological lesion, and possibly requiring only a slight operation. Again, more than three times as many men have died as women. When the element of fear is present, chloroform as a preliminary anæsthetic is contraindicated. We also know that over 2 per cent of chloroform is dangerous to life. But chloroform for certain patients and under certain conditions is by far the safest anæsthetic we can use. Chloroform is especially indicated when the patient is in the Trendelenburg posture, the circulation being fully sustained in this position and a fatality being almost impossible.

Oxygen administered with warm chloroform either by the closed or open method, doubles its value as regards life, and given in this way is as safe as ether and air. Chloroform should usually be avoided as a preliminary anæsthetic, but if used in this way a few drops of cologne on the mask will reassure the patient and disguise the odor so that the anæsthetic is not recognized when given.

Ethyl-chloride. Ethyl-chloride is used principally as a preliminary anæsthetic or for very short operations, and while not as safe generally speaking as nitrous oxide gas, is safer than this gas in certain selected cases. For alcoholics and athletes, and also the obese, it is better than nitrous oxide gas.

No hard and fast rules can be laid down for the administration or for the proper time to switch from one anæsthetic or method of administration to another. This must be learned by experience, and in making these changes the anæsthetist must know the physiological dosage and the effect of each drug that he uses. The fact that these anæsthetics and methods are used in combination and sequence by the best men of to-day is proof positive that no one of them is suitable throughout in many cases. How foolish then for one to suggest or recommend this or that special anæsthetic or method, as, for example, ether by the drop method. This seems like an attempt to fit the anæsthetic to the anæsthetist and not to the patient. Those who recommend the drop method exclusively would be satisfied with an orchestra of one piece and this one piece to have but one string. In going from New York City to some inland place we instinctively take several different classes of vehicles; those best adapted for some special part of our journey — for instance, a cab from hotel to depot, then the railway cars, then possibly the trolley, and lastly, a carriage or some open vehicle. No one would think of taking a cab or a trolley the entire way, although it might be possible to make the journey with either vehicle. The problem of to-day is not the matter of life and death upon the table, but what methods and combinations will give the best results and leave the patient, so far as the anæsthetist is concerned, just as he was before the operation.

To do this the anæsthetist should be equally responsible with the surgeon for the preliminary medication to quiet the nerves of the patient. In addition to the usual routine procedure the anæsthetist should give directions for any medication needed while the patient is being operated upon, and should also be informed and consulted if the patient is nauseated after the operation. In the vast majority of cases we now have no nausea or vomiting, but we should not be satisfied until we can assure all patients that they will come out of the anæsthetic in an absolutely quiet and natural state.

DEPARTMENT OF TECHNIQUE

EXPERIENCES IN CRANIAL SURGERY

By CHARLES A. ELSBERG, M. D.
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I. A Contribution to the Surgical Anatomy and Surgery of the Posterior Cranial Fossa

INTRODUCTORY

Hardly twelve years have passed since v. Bergmann made the oft quoted statement that the surgery of tumors of the brain was limited almost entirely to the central convolutions. He intimated that the outlook for the successful operative treatment of tumors in other parts of the brain was a very poor one. In the past decade, however, great advances have been made. Experimental physiology, clinical medicine, and operative surgery have enriched our knowledge of the focal symptoms of intracranial disease. At the present day we are able to diagnosticate and locate with considerable certainty lesions not only in the central and parietal regions, but also in the occipital and often the frontal lobes, in the hypophysis and the cerebellum.

The increase in our knowledge of the symptomatology of cerebellar disease and the improvements in surgical technique have opened up a new field for surgical endeavor, and already — after the lapse of a few years — the surgery of the posterior cranial fossa has been placed upon a solid foundation.

As is well known, a large number of the tumors that occur in the cerebral hemispheres are gliomata,— tumors which infiltrate the brain tissue. Their radical removal is in many if not in most instances impossible. A much larger proportion of growths in or around the cerebellum are encapsulated and therefore removable. Neuromata, neurofibromata, fibro-sarcomata, in the cerebello-pontine angle, occur with considerable frequency. Much credit should be given to Henneberg and Koch and to Fraenkel and Hunt, who were the first to call especial attention to this class of tumors. Fraenkel and Hunt lay stress upon the fact that these tumors, which originate most often from the auditory nerves, are always well encapsulated, and that their nature and location make them very favorable for operative removal. Cysts of the cerebellum are not so very rare; the same is true of abscesses secondary to otitic disease. The chances for radical removal of infiltrating growths are better in the cerebellum than in the cerebrum. There is a mass of experimental evidence (Luciani, etc.) to show that, after the removal of one cerebellar hemisphere, the other one will take up the functions of both. Total absence of one-half of the whole of the cerebellum has been met with as a chance find on the autopsy table. Many cases have been reported in which a large part of one hemisphere has been removed by the surgeon without permanent symptoms from the loss of cerebellar tissue (Horsley, Krause, Cushing, Frazier, Borchardt, the writer, etc.).

In the following paper, I desire to record the results of investigations into the surgical anatomy of the posterior cranial fossa, and the region which has to be invaded by the operator, together with some remarks on the best method of approach to the various parts of the cerebellum and the cerebello-pontine angle. In a future paper I hope to make a contribution to the symptomatology of subtentorial disease, and to consider the results that have been obtained by operative treatment of subtentorial tumors, based upon a review of the literature and upon the experience I have had at Mt. Sinai Hospital.

The Surgical Anatomy of the Posterior Cranial Fossa and of the Parts Concerned in the Approach to the Cerebellum

Upon the surface of the skull, the region to be considered extends from a short distance above the superior curved lines of the occipital bone above, to the margins of the foramen magnum below, and from the posterior margin of the external auditory meatus on one side to that on the other side. This entire region is within the possible area of operation. In tumors of the upper surface of the cerebellum it may be necessary to remove the occipital bone for 3 to 5 centimeters above the superior curved line, in order that the tentorium can be retracted and the upper surface of the cere-

bellum freely exposed. Where the lesion is situated in the cerebello-pontine angle, it is always necessary to have the opening in the skull or the bone flap extend well into the body of the mastoid process — even to the margin of the bony external auditory meatus.

The *integument* over this region is very thick, especially in the suboccipital region where a large number of muscles are attached. The soft parts are freely movable over both mastoid regions and over the upper part of the occipital bone. Laterally, one to two centimeters below the level of the external occipital protuberance, thick muscles are inserted into the bone, while in the median line, the ligamentum nuchæ has its attachment. The periosteum can be easily separated from the bone down to the level of the muscular and ligamentous attachments. Below this level, the skin with the underlying muscles must be cut close to the bone with scalpel or scissors. The nearer one approaches to the margins of the foramen magnum, the thicker is the mass of muscles that has to be cut. About one centimeter from the margins of the foramen, the muscular attachments cease and the periosteum can again be stripped from the bone with ease. When, in the course of a suboccipital craniotomy, this level is reached,— where there are no more muscular insertions,— the operator will know that he is very near the foramen magnum.

The *blood supply* of the skin and soft parts is mainly derived from the occipital, posterior auricular, and posterior branches of the temporal arteries, on each side. A knowledge of the general location of the main branches of these vessels is of value (see Fig. 1). The vessels usually run underneath the skin in the periosteum or supraperiosteal cellular tissue and send branches into the skin. When a hæmostatic suture (Haidenhain) is to be passed through the scalp before the incision in the soft parts is made, the needle should be passed through all of the soft tissues of the scalp down to the bone.

The operator may expect to meet with two large vessels in the mastoid region. These lie about 3 centimeters apart, the one about 1 centimeter above, the other about 2 centimeters below the level of the external auditory meatus (see Fig. 1). Of two other large vessels that are apt to be cut, one runs in the scalp over the region of the mastoccipital suture, the other about one centimeter from the median line. Along an imaginary horizontal drawn through the external occipital protuberance (see Fig. 1) the one vessel would lie over the junction of the mastoid and occipital bone, the second, about one centimeter from the median

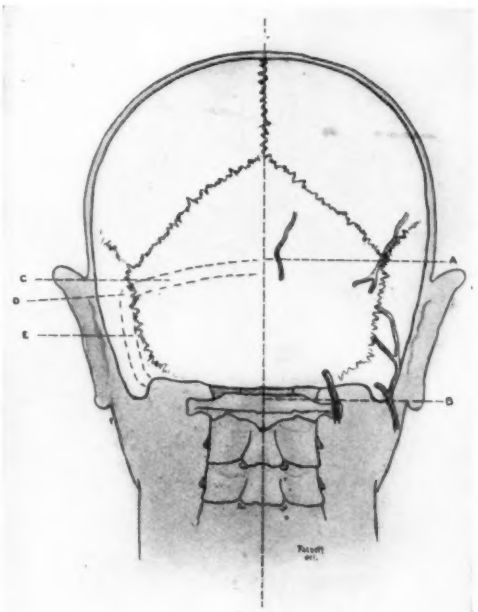

Fig. 1. Posterior aspect of the head. On the right side, the vessels which are divided when the incision in the scalp is made, are shown; on the left side, the course of the sinus is outlined.

line. A large branch of the occipital artery perforates and supplies the muscles in the suboccipital region of each side; this vessel is almost regularly injured when the muscles are being separated from the bone. Along an imaginary horizontal drawn through the tip of the mastoid process, the vessel lies at a point two-thirds of the distance from the median line to the mastoid. When the muscles are being cut free from the bone in this location, one should be on the lookout for this large vessel because the bleeding from it may be troublesome. This I experienced once during the course of a suboccipital decompressive operation. A large branch of this vessel lies in the muscle just internal to the tip of the mastoid and often has to be caught and tied.

In children the *occipital bone* is nowheres very thick, but in adults it may measure more than 1½ centimeters near the external occipital protuberance. The *mastoid process* is usually very thick and often very dense. The thinnest part of the occipital bone lies laterally below the uppermost level of the muscular attachments. This part of the bone should first be removed when an opening in this region of the skull is to be made. It is not

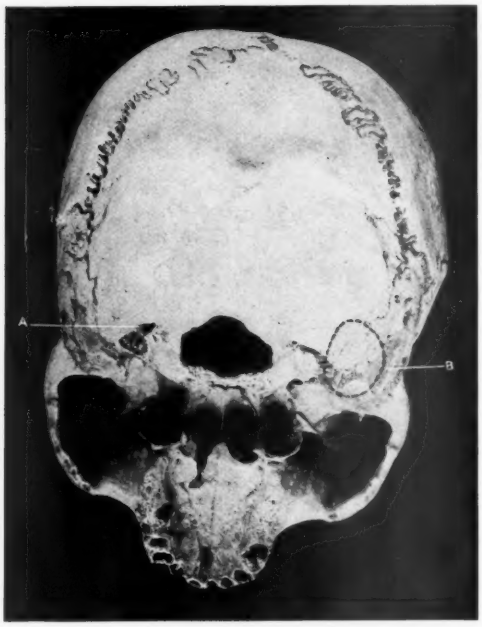

Fig. 2. The location of the large mastoid emissary veins. At A is a large mastoid foramen; at B is outlined the area within which the large veins are most often encountered.

an infrequent error to make the primary opening too high up through thick bone.

From the standpoint of hæmorrhage, most of the *vessels in the bone* are of insignificant size. In the region of the masto-occipital suture, however, one or several large emissary veins may be encountered. These veins empty into the lateral sinus and may attain considerable size. Death has resulted from the loss of blood in the hands of experienced operators, such as Frazier, v. Eiselsberg, Borchardt. In one patient I encountered a mastoid emissary vein that was as large as the lateral sinus, the bleeding from which could only be controlled by means of large wooden plugs hammered into the bone. The danger from injury of these veins must therefore not be underestimated. The difficulties encountered in the control of the bleeding from such a large emissary vein, when a bone flap is being made by means of a drill or biting forceps, is one of the reasons why most operators prefer to remove the bone entirely.

The usual location of the mastoid emissary veins may be seen from the accompanying diagram (see Fig. 2). The large vein is most often encountered on a level with the external auditory meatus and in the region of the masto-occipital suture. A smaller vein which may cause troublesome bleeding runs in the substance of the occipital bone near the knee of the transverse sinus.

Unless there has been a preceding bone disease or pachymeningitis, *the dura* is everywhere loosely attached to the bone and can be stripped off with ease. Occasionally, the dura will be more firmly attached to the bone along the side of the torcular and along the inner part of the transverse sinus.

The exact *course of the transverse sinus* will be found to correspond to a line drawn from the external occipital protuberance to the base of the mastoid process or to the depression which corresponds to the parieto-mastoid suture (Kocher); the bend or knee of the sinus lies in this latter region, from which the lateral sinus runs vertically downward underneath the middle of the mastoid process. At the bend or knee, the sinus is sometimes joined by a small vein from the lateral edge of the cerebellar hemisphere. Several small veins frequently run from the upper surface of the hemisphere to the transverse sinus near the median line. These veins may be injured when the dura is incised,or they may be torn when the dura is retracted. In either case, a small but disagreeable hæmorrhage into the lateral recess of the posterior fossa may take place. The course of the superior longitudinal and occipital sinuses is so well known that a description is unnecessary. Mention must be made of a small but important sinus which runs around the edge of the foramen magnum. This "marginal" sinus is mentioned only by Borchardt and Krause. I have once seen a very troublesome hæmorrhage from an injury to this sinus.

After the removal of the bony covering of the posterior fossa, and after the free incision of the dura, only a small part of the cerebellar hemisphere will be exposed. If more of the cerebellum is to be brought into view or if the deeper parts of the posterior fossa are to be explored, retraction of the tentorium or of the cerebellum itself is necessary. The cerebellum fits snugly into the bony walls of the posterior fossa with the exception of the outer border and the under surface of each hemisphere. On the outer border there is, normally, a space which measures about one centimeter in its transverse diameter, which contains cerebrospinal fluid. This "lateral recess" of the posterior fossa is the one which forms the entrance into the cerebello-pontine angle.

The dislocation of the cerebellum can be best accomplished by traction towards the median line. The retractor should not be placed upon the under surface of the lobe, as is often done, but upon the

outer edge and well up on the upper surface. If the cerebellar lobe is gradualty lifted out of its bed in the manner which will be described later, more and more of the posterior surface of the petrous portion of the temporal bone will become visible. In the depth, the internal auditory meatus will be seen with the facial and auditory nerves entering it. The facial nerve lies in front of and somewhat deeper than the auditory nerve, and the nerves can be isolated from each other with little difficulty. Just in front of the nerves and somewhat more deeply, one may sometimes see several small veins which run from the lateral edge of the cerebellar lobe to the superior petrosal sinus. These are the veins which may cause troublesome oozing of blood when a tumor in the cerebello-pontine angle is removed. More posteriorly toward the foramen magnum lie the ninth, tenth, and eleventh nerves, but they can only be brought into plain view by raising the cerebellar hemisphere partly out of its bed. To expose the twelfth nerve, a retractor is placed upon the under surface of the lobe and the lobe raised up gently. A second retractor is passed more deeply and nearer the outer edge of the lobe. When retraction is made the twelfth nerve and part of the margin of the foramen magnum come into view.

The shortest distance from the internal auditory meatus and the facial and auditory nerves to the surface of the skull is measured along a line which runs along the posterior surface of the petrous portion of the temporal bone and reaches the surface of the skull 1 to 2 centimeters behind the bony external auditory meatus. The distance from the outer surface of the occipital bone below the level of the lateral sinus to the anterior edge of the cerebellum diminishes steadily as measurements more and more distant from the median line are made. I have made measurements in a large number of skulls, and have found in adults that the average distance from the surface of the occipital bone (see Fig. 3, line A) to the internal meatus is 5 to 6 cm., while the average distance from the surface of the mastoid about one centimeter behind the external auditory meatus to the internal auditory meatus (line B) measures 4.5 cm.

These measurements show that the shortest route to the cerebello-pontine angle is from the mastoid region along the posterior surface of the petrous portion of the temporal bone. The lateral part of each cerebellar lobe is the part that can be most easily retracted and it is also the part that can be handled with greatest safety. Therefore, the approach to the cerebello-pontine angle and the anterior edge of a cerebellar hemisphere along the outer edge of the lobe is not only the easiest route but also the one by which the organ is least apt to be seriously injured during the necessary manipulations.

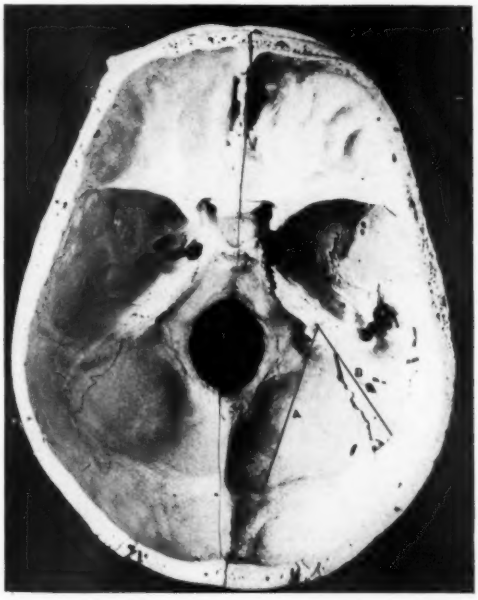

Fig. 3. The inner aspect of the base of the skull, to show that the distance from the mastoid region to the internal auditory meatus (line B) is smaller than the distance from the suboccipital region to the same point (line A).

The Surgical Procedures for the Exposure of Tumors of the Cerebellum and of the Cerebello-pontine Angle

Some general details of technique are worthy of special consideration:

Shall an osteoplastic flap be made or is it preferable to remove the bone? Shall the opening in the skull be made on one side, or shall a bilateral exposure of both lobes be made? What are the dangers of lumbar puncture in subtentorial lesions? Operations in two stages and the value of estimations of the blood pressure. The question of the anæsthetic.

Shall an osteoplastic flap be made or shall the bone be removed? In decompressive operations the bone must, of course, always be removed. When the operation is performed in order to expose and remove a new growth, some operators (Krause, Borchardt) frequently make an osteoplastic flap, while others (Cushing, Frazier, Horsley) remove the bone in every case. The suboccipital region is well covered by muscles which will give a good

support to the cerebellum when the bone has been removed. A bone flap will occupy a certain amount of space in a region where much room is needed for manipulations and should therefore, if possible, be dispensed with.

When is a bilateral exposure of both lobes of the cerebellum indicated? Cushing makes a bilateral exposure in every instance; Krause, Borchardt, and others do it frequently; Frazier believes it is but rarely required. Cushing states that with a bilateral exposure, the dislocation of the cerebellum is much more easy. When there is reason to believe that the lesion is a bilateral one or in the worm, his view is undoubtedly correct. But if the lesion is clearly unilateral, I agree with Frazier that a large opening on the affected side will suffice. If the bone is removed well above the superior curved line of the occiput, well into the mastoid, and up to or across the median line, the exposure of the cerebellar lobe is sufficient for all purposes. All parts of the cranial fossa on that side can be examined, the cerebellar lobe can be lifted out of its bed so that the cerebello-pontine angle can be clearly exposed, and the seventh, eighth, ninth, tenth, eleventh, and twelfth cranial nerves as well as almost all parts of the cerebellar hemisphere brought into plain view. In a considerable number of operations for disease in the posterior cranial fossa, I have never seen dangerous symptoms from pressure on the pons or medulla when the cerebellar lobe was retracted, as long as this was carefully done.

The accompanying photographs (Figs. 4 to 7) are given to show the appearance of patients after a unilateral exposure of a cerebellar hemisphere. If the cause of the increased intracranial pressure persists, or the asepsis of the wound has not been perfect, a protrusion will occur no matter how well the soft parts of the scalp have healed. The full effect of a decompression can be obtained by a unilateral removal of the bone with excision of the dura. The appearance of the head after a bilateral removal of the bone is often very satisfactory (Fig. 8). If the suspected tumor is not found on the side upon which the operation has been performed and there are sufficient grounds for the exposure of the other side, this can be done at once or in a second stage.

The danger from lumbar puncture in subtentorial disease. Most writers warn against lumbar puncture in subtentorial neoplasms and state that the danger of sudden death is a very great one. When, in these patients, fluid is withdrawn from the spinal canal the cerebellum is forced into the foramen magnum. Cushing and Frazier declare that lumbar puncture should never be done.

Fig. 4. To show configuration of the head two months after suboccipital craniotomy with removal of the bone. Excision of cerebellar cyst, complete recovery.

Although I have twice seen sudden death from this procedure in the hands of colleagues, I have never had the misfortune to have it occur in one of my patients. In the very few cases of suspected subtentorial growths in which I have aspirated the spinal canal for diagnostic or therapeutic purposes,

Fig. 5. The same patient as Fig. 4. To show absence of hernial protrusion.

Fig. 6. To show configuration of the head sixteen months after suboccipital craniotomy with removal of the bone for glioma of the cerebellum.

Fig. 7. Configuration of the head three months after craniotomy with removal of the bone on one side, for tumor of the cerebello-pontine angle. Neuro-fibroma of the auditory nerve successfully removed.

Fig. 8. Configuration of the head three months after bilateral suboccipital craniotomy with removal of the bone for glioma of the fourth ventricle probably originating from the ependyma.

I have kept the patients in the exaggerated Trendelenburg posture. In the head downward position, gravity will partly counteract the tendency of the cerebellum to fall or be forced into the foramen magnum when the intraspinal pressure is suddenly relieved. I have done a lumbar puncture quite frequently in chronic hydrocephalus with a predominance of cerebellar symptoms, and in posterior basic meningitis of infants, without bad results. Although I do not think that the dangers of a lumbar puncture are as great if the patient is kept in the Trendelenburg posture, it is safer not to puncture the spine in a suspected subtentorial neoplasm.

Operations in two or more stages, and the value of blood pressure estimations. The constant control of the general blood pressure during an operation in the posterior fossa is of much value and should never be omitted. A decided fall in blood pressure is always a warning sign. It is of as much value in brain surgery as the control of the pulse. If, during the operation, the pressure remains high, the operation can be finished in one stage; if the pressure falls gradually, as it does in most of the cases, the manipulations can be continued until the pressure has dropped 40–50 points. If the pressure still continues to fall, the remainder of the operation should be put off until a later time.

If the pressure falls very quickly, the operation must be finished rapidly or must be stopped for the time being. If proper heed is given to the warning signals of a rapid fall in the blood pressure, the patient's condition will at once improve when the skin flap is returned into place. My concern for a patient in poor condition always grows less as soon as I am informed that the pressure is rising while the skin flap is being sutured. In several patients I have been able to finish the operation by giving an intravenous infusion of 0.9 per cent salt solution as soon as the blood pressure began to fall rapidly. In a recent case of neuro-fibroma of the auditory nerve, in which the operation had to be divided into three stages, the tumor was just about to be lifted out when the blood pressure dropped 30 points and the patient's general condition became poor. Everything had been kept in readiness for the intravenous infusion; it was given at once, and the operation continued and brought to a successful conclusion. I have not made use of the method of sequestration anæmia recommended by Dawbarn. If bleeding is prevented in the manner that will be described later, there is no necessity for the exclusion of a large quantity of blood from the general circulation. Although the release of the blood in the extremities, by the removal of the elastic bandages, can have only a good effect upon the general condition of the patient, the exclusion of the blood may diminish the resistance of the patient. It may give the operator an incorrect idea of the true condition of the patient during the operation.

If an operation is done in two stages, the operator should mark the course of the transverse and lateral sinus by means of a few silk sutures. At the second operation, it is sometimes impossible to see the exact limits of the sinuses and hence they may easily be injured, unless their course and limits are marked out plainly.

The question of anæsthesia. The services of an experienced anæsthetist are invaluable for all cranial operations, and the surgeon who does much intracranial work should have the same narcotizer for all of his patients. After having used both ether and chloroform for anæsthesia, I have learned that chloroform, as recommended by Horsley, is preferable. When chloroform is used, hæmorrhage is smaller, and the bulging of the cerebellum is less when the dura is incised. Because of the proximity of the medulla, I have never attempted to do, as has been recommended, the second stage of an operation for tumor in the *posterior* fossa without anæsthesia.

Drainage after intracranial operations for tumor in the posterior fossa. Drainage should never be employed unless an otherwise uncontrollable hæmorrhage has been encountered. The danger of secondary infection after drainage is very great, and it should be an almost invariable rule to close the dura as completely as possible and to close the skin wound entirely. If the intradural manipulations are very carefully done, all bleeding can be controlled by ligatures applied to bleeding vessels which can be seen or by means of temporary packings of absorbent cotton or gauze.

The operative procedures. In male patients the entire head should be shaved, while in women the front part of the hair can be preserved. If the hair is shaved from the back and top of the head as far forward as a line connecting the anterior edges of the ears, the field of operation can be rendered aseptic, and much hair saved.

The patient is placed upon the table almost flat upon the abdomen with a large pillow under the side of the chest. The head is moderately flexed upon the thorax. In this position, the side of the head to be operated is turned upwards. By means of the pillow, the chest is raised from the operating table so that breathing is not interfered with. The anæsthetizer is seated by the side of the table and is never in the way of the operator or his assistants. With the patient in this position, all of one and the greater part of the other suboccipital region are well exposed (Fig. 9). In those patients, and the cases are rare, in which the bone is to be removed from both sides, the patients are placed flat upon the abdomen with the head projecting beyond the end of the table, and a pillow under the shoulders. The head rests face downward upon a head rest which has been devised by the writer and which fits into a modified Hartley head attachment (see Figs. 10 and 11). For unilateral exposures, however, no head rest is required.

After the head has been cleaned and surrounded by sheets and towels so that the field of operation is completely isolated, a hæmostatic suture, threaded on a large, full curved needle, is passed. The suture begins on the neck about two inches below the tip of the mastoid process and somewhat within it, passes upwards just behind the root of the ear, curves inwards about one inch above the level of the external occipital protuberance, crosses the median line for about two inches, then turns downward, stops on the back of the neck on a level with the beginning of the suture, and then passes across the neck to the starting point (Fig. 12). In the nape of the neck the needle must be deeply passed; over the skull the needle must be passed down to the bone. If this suture has been well applied, there will be very little bleeding from the

Fig. 9. Position of the patient for unilateral suboccipital craniotomy.

scalp when the incision is made. I have never found the double row of sutures as recommended by Haidenhain necessary; a complete single row of sutures surrounding the entire field of operation will suffice.[1]

The incision in the scalp runs parallel to the hæmostatic suture and about ½ centimeter within it; over the occiput and mastoid the knife cuts down to bone. With a raspatory, the skin and periosteum are separated from the bone and turned down until the level of muscular insertions is reached. The muscular attachments are cut close to the bone with strong curved scissors. If branches of the occipital artery near the tip of the mastoid bleed, they must be caught and tied. The muscles are cut free from the bone until the attachments cease. The skin-periosteum-muscle flap is now well retracted, and with an ordinary

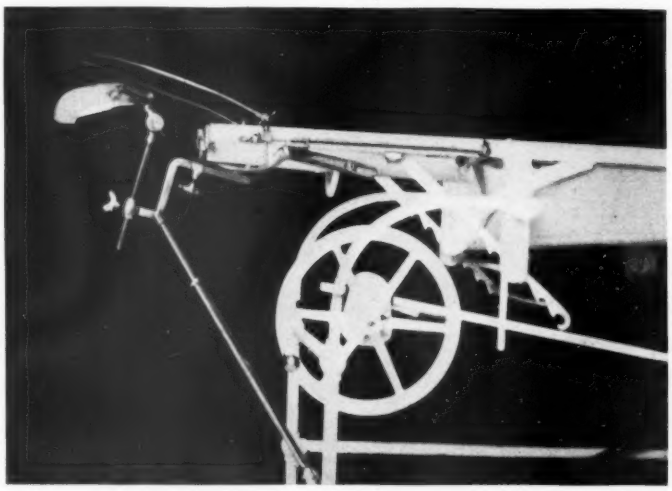

Fig. 10. Hartley head rest as modified by the author for bilateral exposure of the cerebellum. Author's curved rod for sheets and towels which isolate the field of operation.

[1] When a bilateral exposure is to be made, the hæmostatic suture must, of course, include both sides of the scalp.

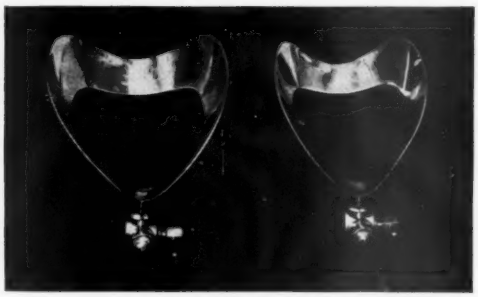

Fig. 11. Head rests for bilateral suboccipital craniotomy. The patient's forehead rests upon the upper and the chin upon the lower part of the head rest. The anæsthesia is given from underneath.

hand trephine of about one inch diameter, a button of bone is removed several centimeters below the highest level of muscular attachments. With strong cutting rongeurs, the opening is rapidly enlarged in all directions until the dura 1–2 centimeters above the transverse sinus is exposed, above, and a small part of the dura on the other side of the median line internally. Below, the bone is removed up to or into the foramen. Laterally, the bone is rongeured away well into the mastoid process, until most of the lateral sinus lies exposed (Fig. 12). All bleeding from the

Fig. 12. Unilateral suboccipital craniotomy with removal of the bone. The hæmostatic suture in place, the skin-periosteum-muscle flap turned down, and the bone removed. The broken line indicates the location of the incision of the dura, close to the sinus.

bone is stopped with Horsley wax, and bleeding from large mastoid emissary veins is stopped by hammering wooden plugs into the openings. A full supply of variously sized wooden plugs should be on hand, and the assistant at the instrument table should have them ready when the bone of the mastoid is being cut through. Thus far, the operation should have lasted less than one-half hour; I have consumed only twenty minutes in some of my cases.[1]

Underneath the dura, the occipital lobe of the brain will now be seen above the transverse sinus and the cerebellum, below. The dura is normally very tense in this region, so that it is difficult to distinguish any change in tension unless it is very well marked. If the operation can be continued, larger vessels in the dura must be doubly ligated with fine silk and all oozing stopped. The dura is then incised parallel to the sinus and about five millimeters from it. Constant irrigation with warm normal saline solution is now begun and is to be continued with intermissions until the operation is completed.

The best manner of incising the dura is to make a small opening with a fine scalpel, and then to cut the dura on a grooved director passed through the opening. As the membrane is cut and the cerebellum bulges, especial care must be taken not to injure the delicate pia arachnoid covering of the hemisphere (Fig. 13). The hemisphere should be carefully palpated and should be aspirated if an intracerebellar tumor or cyst is suspected. If a cyst is found, an incision is made through one of the sulci, the cavity exposed, and the lining membrane of the cyst carefully excised. If the lining membrane is too thin, the inner wall of the cyst should be cauterized with strong tincture of iodine. If an encapsulated growth is found it must be carefully peeled out, or if the growth is an infiltrating one, it must be widely excised. The operator should not hesitate to excise one-half or even two-thirds of the hemisphere. The bleeding from the cerebellum is always very slight, and can be best controlled by pressure with small wads of absorbent cotton as recommended by Cushing. One seldom has to ligate a bleeding vessel. All oozing must be stopped before the dura is closed.

When the various surfaces of the cerebellum are to be exposed or the bony wall of the cavity to be examined the following course should be adopted. I need hardly state that if the exact location of

[1] If the operation is only a decompressive one, then the amount of bone to be removed is of course much smaller than above mentioned. The opening in the bone should measure about 4 by 6 centimeters. A piece of dura about 3 by 5 centimeters should be excised, or better, only a crucial incision in the dura made.

Fig. 13. Unilateral suboccipital craniotomy with removal of the bone. The dural flap reflected showing the protrusion of the cerebellar hemisphere.

the tumor has been diagnosticated beforehand, that part of the fossa must first be exposed. The dural incision must be very large so that the entire cerebellar hemisphere can bulge through it. If the upper part of the dural incision has been made near the transverse sinus, the upper surface of the hemisphere will be on a level with the incision, and therefore easily examined. For the retraction of the cerebellum I make use of flexible retractors of German silver (see Fig. 14). These retractors have varying widths and can be bent as desired.

To expose the upper surface of the hemisphere, the tentorium is raised with a broad retractor. The entire upper surface can be seen and examined without difficulty; to bring the most anterior part into view, the cerebellum must be gently depressed with another retractor. If a tumor is found it must be dealt with as described below. By inserting a narrow retractor on the mesial side of the hemisphere and drawing the lobe gently outwards, the mesial side of the lobe and the posterior part of the worm can be seen. By inserting a broad retractor under the hemisphere and raising it, the greater part of the under surface, the floor of the fossa, the twelfth cranial nerve, and the margin of the foramen with the medulla can be brought into view (Fig. 15). An electric headlight is invaluable for the thorough exploration. By inserting one retractor over the other as described below one can obtain an excellent view of all the structures, without causing any injury to the cerebellar tissue.

The exposure of the cerebello-pontine angle and the seventh and eighth nerves as well as the ninth, tenth, and eleventh nerves is accomplished in the following manner. The smallest retractor bent as desired is carefully inserted along the outer edge of the hemisphere along the petrous portion of the temporal bone. After it has been introduced for several inches, the hemisphere is slowly drawn toward the median line and the bone exposed. A broader retractor is then introduced more deeply before the first retractor is withdrawn. When the hemisphere is drawn inwards with this retractor, the internal auditory meatus with the nerves entering into it

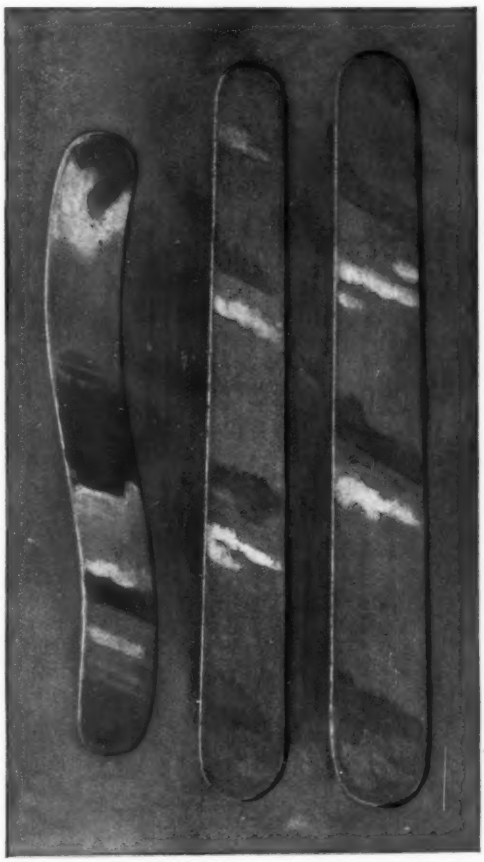

Fig. 14. Flexible retractors of German silver for use in the retraction of the cerebellum.

Fig. 15. Unilateral suboccipital craniotomy with removal of the bone. The cerebellar hemisphere has been raised and the margin of the foramen magnum, the side of the medulla oblongata, the hypoglossal nerve, and the floor of the posterior fossa of the operated side are plainly visible.

can be plainly seen (Fig. 15). At this time there is apt to be an escape of considerable cerebro-spinal fluid which must be carefully sponged away. If there is a tumor in this region, it will be seen lying on the petrous portion of the temporal bone, a bluish or reddish white mass with a well defined capsule (Fig. 17). The inspection of the region must be done very carefully. If the tumor is very small, it might be missed entirely; if the tumor is very large it may appear to be a part of the cerebellum. However, the smooth glistening surface which these growths present, with small blood-vessels running over them, will usually make their recognition an easy matter.[1] If no growth is found the hemisphere is gently drawn more towards the median line, when the other cranial nerves can be seen. The manipulations for the removal of a tumor in the cerebello-pontine angle must be most carefully done, and the entire success of the operation will depend upon the care and the skill of the operator. If the auditory nerve can be seen entering the tumor, it must be divided with fine scissors. If a lateral cerebellar vein is seen above the growth, it must be divided between fine silk ligatures. In freeing the growth from its surroundings, it is of the utmost importance to begin on the inner side of the growth and to work away from the pons and medulla. I usually pass a small elevator along the inner side of the tumor and working outwards, always away from the pons and medulla, free the growth, by slowly passing the elevator around it. When the tumor has been isolated on all sides, and is felt to be free, I pass a small spoon along its inner side and gently and slowly lift it out. If there are adhesions between the tumor and the medulla, these must be separated with great gentleness. The growth should never be torn or twisted off. It must be carefully cut free from its mesial attachments, if these are firm, with a small, blunt-pointed scissors curved on the flat. This must be done under the eye of the operator and the parts must be well exposed and a good light thrown into the fossa. Injury to the medulla from tearing out of the tumor has been responsible for a number of deaths which have been reported in the literature of the subject. It is not a good plan to grasp the growth with a clamp or forceps as the capsule is very thin and ruptures easily. If great care is taken, there will be little oozing of blood from the bed in which the tumor lay. If there is some oozing, it must be entirely

[1] I strongly advise against the exploration of the cerebello-pontine region with the finger. Recently the statement has been made (Lecene, Journal de Chirurgie, April, 1909, page 371) that the best guide in the exploration of the region is the finger. If the region is well exposed and a good light is thrown into it, every part of the angle can be plainly seen.

Fig. 16. Unilateral suboccipital craniotomy with removal of the bone. The cerebellar hemisphere has been drawn toward the median line and the posterior surface of the petrous portion of the temporal bone, the internal auditory meatus, and the facial and auditory nerves exposed. Note the small lateral cerebellar vein above and in front of the nerves, running to the superior petrosal sinus.

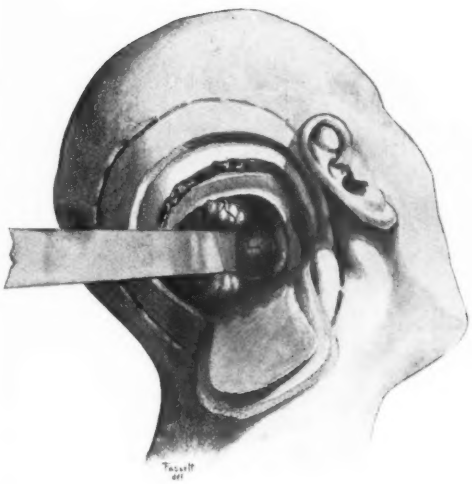

Fig. 17. Unilateral suboccipital craniotomy with removal of the bone. The exposure of a tumor in the cerebello-pontine angle. Patient with a fibro-sarcoma of the auditory nerve successfully removed at operation. Death three months later from another tumor in an inoperable location.

controlled by packing the cavity lightly with gauze for a few minutes. Occasionally it will happen that the capsule of the tumor ruptures. Then the growth will have to be extracted piecemeal with a sharp spoon, care being taken that the capsule is finally removed. The cavity is then thoroughly irrigated with salt solution.

The isolation and removal of extracerebellar growths in other parts of the fossa must be accomplished along similar lines to those laid down for the removal of cerebello-pontine tumors.

If a bilateral removal of the bone has been performed, it may not be necessary to incise the dura on both sides. If both lobes of the cerebellum are to be exposed, the occipital sinus will have to be ligated in two places. This can best be accomplished in the following manner. Small incisions are made in the dura on each side of the sinus and through the one incision a Déchamps or ordinary large, sharp aneurism needle is passed. The needle, threaded with stout catgut, is made to pass through the falx cerebelli and to emerge through the dural incision on the other side. The ligature is then tied. Between two ligatures the sinus is divided. If a transverse sinus must be divided or has been injured, it can be ligated in a similar manner. Neither sinus should be ligated near the torcular, but this is not apt to be done because the bone near the torcular should always be preserved.

Whenever possible, the dura should be tightly closed by means of sutures of fine silk; this can be successfully accomplished in about one-half of the cases. Often the dura can be only partially closed on account of the protrusion of the hemisphere. In some cases the cerebellum will recede after lumbar puncture, which can be done without danger. If part of the hemisphere has been much lacerated, that part should be excised with fine scissors before the dura is closed, but injury of the cerebellar tissue can and should be avoided in the majority of the operations. If the dura can not be sutured, it is a good plan to cover the exposed part with a piece of sterile Cargile membrane which is attached to the surrounding dura by a few fine silk sutures. Finally, after every vestige of oozing of blood has ceased, the entire wound is again thoroughly irrigated with saline solution, the periosteum-skin flap is turned back into place, and sutured with numerous silk sutures. The accurate approximation of the cut skin edges is of great importance for the prevention of cerebro-spinal fluid leakage after the operation. The interrupted silk sutures should be applied so that they run somewhat obliquely across the skin edges. The loops of the hæmostatic suture in the scalp are then cut and removed. In conclusion, the point of the irrigator is passed under the skin flap between two sutures and the wound again thoroughly irrigated with salt solution. A firm, dry dressing is then applied.

The after treatment. A few features of the after treatment are of importance. The wound should be dressed on the fourth or fifth day, then all of the silk sutures are removed and the skin strapped with narrow strips of sterile adhesive plaster.

All patients should receive 7–10 grains of urotropin three times a day for several weeks, unless signs of renal irritation appear. Crowe has recently shown that urotropin as such or as formaldehyde enters the cerebro-spinal fluid, and is able to render it sterile; I have gained the impression that the drug has a distinct value in the prevention of infection — especially in those cases in which there is leakage of cerebro-spinal fluid.

No matter how carefully the wound has been closed, leakage of cerebro-spinal fluid may occur several days after the operation. Very large quantities of cerebro-spinal fluid may escape daily, sufficient to soak through all of the dressings and the bed clothes. The dressings should be changed under the most rigid aseptic precautions, as there is danger of infection of the meninges through the fistulous tract. Whenever, in such a case, a fresh

dressing is applied, the skin around the fistulous opening should be painted with tincture of iodine. If great care is taken to prevent infection, the discharge will usually cease within a few days and the small opening will close.

Morphine should be given with much circumspection during the first few days after the operation; the patients are very susceptible to the drug. In several patients I have seen the respirations fall to 10–12 per minute a short time after $\frac{1}{8}$ of a grain of morphine sulphate had been given hypodermatically.

The symptoms presented by the patients who have been operated upon for cerebellar disease, especially the subjects of shock and respiratory failure after surgical intervention for disease in the posterior cranial fossa, will be considered in a subsequent paper.

INGUINAL HERNIA OF THE RUDIMENTARY HORN OF THE UTERUS AND ADNEXA IN AN INFANT WITH EXTERNAL GENITALS OF AN INTERMEDIATE TYPE

By HAROLD UPCOTT, F. R. C. S., Hull, England
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CASES illustrating a lack of fusion of the Müllerian ducts for a greater or less part of their extent are not uncommonly reported in the literature. Most of these are met with in adults and the bicornuate condition of the uterus is first discovered when one or the other horn has become pregnant or is the seat of retained menses. In most of these cases the external genitalia do not share in the deformity.

In children below the age of puberty the condition is less often observed, for neither of the above faults is operative in drawing attention to the deformity. It is only when the malformation is associated with a hernia of one of the internal genital organs, or when the external parts are abnormal, that the defect is likely to be noticed. The following case is an example of this latter class.

Jesse B. Aged 7 months, was sent to me in the beginning of May, 1909, by Dr. Powers of Brigg, for the cure of a left inguinal hernia. On examining the child, a particularly robust and healthy looking infant, the external genitals are seen to be of the pseudo-hermaphrodite type. (Fig. 1.) The penis is about one inch in length with a well formed glans presenting a dimple at its tip. Extending backwards on either side from the penis are the halves of the scrotum or labia majora; between these the penis is held down by a mucous fold attached along its under surface. At the posterior extremity of this fold is a small opening which ends blindly about a quarter of an inch from the surface. Just within this opening, on its anterior wall, is the urethral orifice.

The left labium is occupied by an inguinal hernia apparently containing bowel which is reducible. In the right labium could be felt a small oval movable body about one-third of an inch in length. No hernia was detected on this side.

No uterus could be felt on rectal examination. When dissecting out the hernial sac a little oval body was seen projecting slightly from its inner surface; this was taken to be a very atrophic testis and was removed with the sac.

Subsequent examination shows, in the wall of the hernial sac and projecting on its peritoneal aspect, an oval body 1.5 cm. long and .6 cm. broad. (Fig. 2 A.) One end tapers suddenly to a cord 1 cm. long which can be felt beneath the peritoneum. From the other end, which is blunter, comes off a strand, 3.5 cm. long, with a fimbriated extremity. (Fig. 2 B.) Into the distal 1.5 cm. of this a fine probe can be passed. Springing from the angle between this duct and the oval body is another strand of tissue, its distal tapering extremity appearing to join the fimbriated end of the previous duct. Placed on the middle of this strand is a raised, elongated, reddish area 1 cm. in length. (Fig. 2 C.) Beneath the peritoneum lying between the duct and this elongated body, and running from one to the other, can be seen several parallel whitish bands. (Fig. 2 D.)

Transverse sections of the larger oval body show it to be a thick-walled muscular tube with a flattened lumen lined with a single layer of columnar epithelium (Fig. 3) the unstriped muscle fibres in the wall of this tube being arranged in interlacing bundles. (Fig. 4.) This oval body, then, represents that part of the Müllerian duct which takes part in the formation of the uterus. That which is (strictly speaking) the cephala segment of the Müllerian duct is represented by the tube having a fimbriated extremity. At the junction

Fig. 1.

of these two segments the peritoneum is raised by a stout fibromuscular cord, the inguinal fold (Fig. 2 E), the precursor of the round ligament.

Microscopical sections of the minute raised area already mentioned show it to have the structure of a developing ovary. The cellular stroma is traversed by anastomosing columns of more deeply staining polyhedral cells with large nuclei. These are in many places broken up into groups in which the polyhedral cells tend to assume a peripheral arrangement around a larger, poorly staining cell. (Fig. 5.)

So far as the investigation goes the organs that have come to light, though undeveloped, it is true, are unquestionably female in character. There are, however, possibilities in the right labium to be considered before pronouncing upon the nature, and sex, of the case.

The organs I have described may be present in duplicate upon the opposite side; in this event the individual is a female with a rudimentary uterus didelphys and immature ovaries. On the other hand the right labium may contain a testis; the condition then would be one of lateral hermaphroditism with dominance of the male element. If this were so the child would probably develop masculine characters as in Kellock's case[1] where male was dominant on the left and recessive on the right.

It does not appear to me possible to say which of the two interpretations is the right one; though since hermaphroditism is infinitely more rare than maldevelopments of the uterus, the case is probably one of uterus didelphys.

The inclusion of the genital organs within a

[1] Proc. Roy. Soc. Med., 1908, Clin., iii.

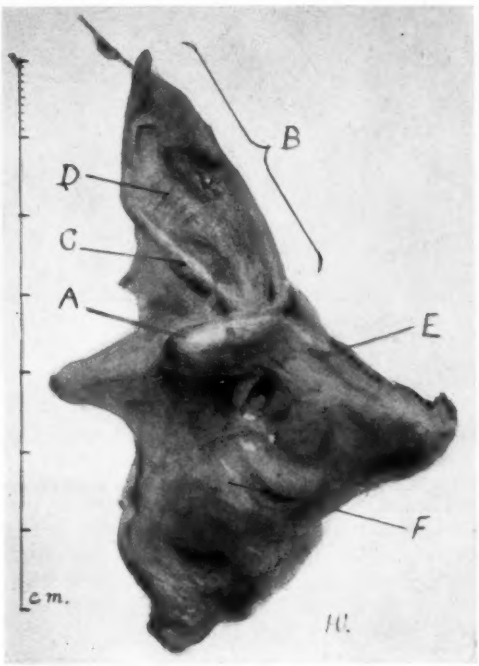

Fig. 2.

hernial sac must not be regarded as the cause of their lack of development but rather as an expression of the congenital anomaly, a fault in sexual differentiation.

The recorded cases of inguinal hernia containing the uterus have recently been studied by Cranwell[2] who has collected 45 observations from the literature, adding to these a case

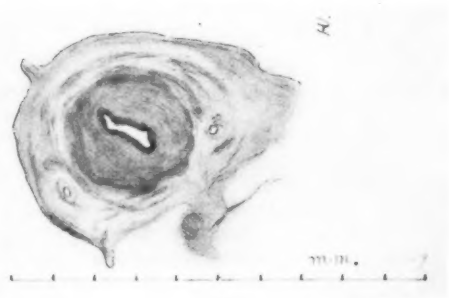

Fig. 3.

[2] Rev. de Gyn. et de Chir. Abdom., 1908, xii, 777.

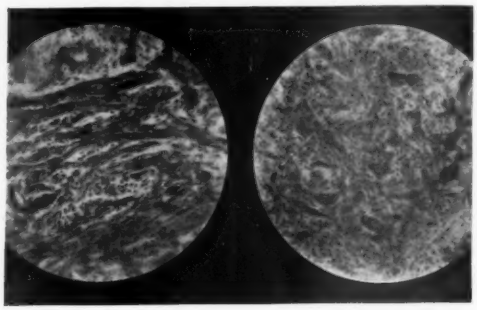

Fig. 4. Fig. 5.

of his own. He considers that 32 of these cases were congenital, an opinion strengthened by the fact that hernia of the uterus is so often associated with badly developed internal organs of generation, such as uterus bicornis, uterus bipartitus, uterus duplex, rudimentary uterus, rudimentary ovary, absence of one or both ovaries, obliteration or absence of the tubes, absence of the vagina, and hermaphroditism true or false. Malformations of the external genitalia in these cases are less often met with.

Cranwell divides the "inguinal hysteroceles" into two groups: acquired and congenital. He further subdivides the latter class into those dependent upon the prolapse of an ovary into a patent canal of Nuck which subsequently draws the uterus down after it, and the true congenital type in which there is an ectopy of the genital organs, as in my case.

The social status of this child is somewhat perplexing, indeed the parents' choice of a name is suggestive of doubt on this score. It was my original intention to restore the urethra to the male type when the child was a few years older; but since the only positive evidence of sex points to femininity any such operative interference seems to be flying in the face of Providence; rather would it seem better to form an artificial vagina as was done by Schwartz [1] in a very similar case. Nevertheless it is, for obvious reasons, desirable to bring up the child as a boy, leaving the question of dominant sex to be settled by the lapse of time and, possibly, by the occurrence of a right inguinal hernia.

[1] Quoted by Cranwell, loc. cit.

A NEW OPERATION FOR RADICAL CURE OF FEMORAL HERNIA

With Report of a Case

By BENJ. B. CATES, M. D., Knoxville, Tennessee

In order to make a successful operation for the radical cure of femoral hernia, the surgeon attempts to overcome in an artificial way the defects of nature, caused by a relaxation or giving way of the tissues around the exit of structures passing beneath Poupart's ligament.

To do this, the surgeon attempts to obliterate these weak places by causing a fusion of those tissues that form the boundaries of potential openings that may and do become actual openings in herniæ, below Poupart's ligament.

I have never been convinced in my mind that the operations heretofore practiced were sound surgical methods, because the field of vision was too limited, and there was not a complete welding of the different tissues through which the hernia passed to obliterate these openings, by those methods as now practiced.

So, recently I had the opportunity to put into practice an idea I have some time had in mind in regard to the radical cure of femoral hernia.

In order to understand the technique I advocate and practiced in my method, I will give a history of the case, and then detail the different steps of the operation.

On the afternoon of June 15, 1909, I was asked by Dr. S. L. Jones to operate on a patient of his who was suffering with a strangulated femoral hernia.

History. Tobe Clark, white, male, aged 42, a locomotive engineer. Was perfectly well up to two years ago, when he noticed a small tumor in left groin. The tumor was not painful and would disappear on lying down, and would remain away some time, perhaps a month, when, on doing some heavy lifting, it would reappear.

Six days before the operation, in the morning after breakfast, he commenced to have severe pain in the epigas-

trium; at the same time the tumor appeared in the groin and was larger than it had ever been. This pain in the epigastrium, with vomiting, kept up till the day of the operation. He did not consult a physician for two or three days, and then, against the advice of his physician would not consent to operation till he had stercoraceous vomiting, which occurred on the sixth day after he took sick.

Operation. Assisted by Dr. C. Deaderick and S. L. Jones, we made an incision five inches long, below and parallel to Poupart's ligament, commencing at spine of pubis and running outwards.

Coming down upon the sac (which was gangrenous) we opened it in order to examine its contents. A small quantity of dark, fetid fluid escaped. The sac contained about two inches of necrotic small bowel.

Then with a piece of gauze around the index finger, we loosened all the tissues around the neck of the sac. Having done this, with scissors, we trimmed away all the necrotic parts of the sac, wiped out its bed, and covered the necrotic knuckle of gut with gauze.

The next step in the operation was to grasp the falciform and Poupart's ligament with Ochsner's forceps above the neck of the sac, and with blunt scissors cut through these tissues with successive nicks of the scissors.

By nicking and sponging back the soft tissues, we were enabled, without damage to any important structures, to enlarge the opening sufficiently to get a good view of everything and to bring a sufficient length of gut outside the belly to get sound gut for making resection and end to end anastamosis.

We resected between six and eight inches of gut by the Kocher-Moynihan suture method.

The next step in the operation was to close the opening in the sac by interrupted sutures of catgut, and then unite Poupart's ligament (without attempting to restore its continuity) to the pubic portion of the fascia lata.

Having done this, we closed the wound in the skin with silkworm gut sutures, after putting an iodoform gauze wick in the lower angle of the wound, and another about an inch lower down through a stab wound in the skin, so as to drain the lower limit of the bed in which the sac lay. The patient made a good recovery with a good result.

To recapitulate. Make the incision through the skin about one inch below and parallel with Poupart's ligament, commencing at the spine of the os pubis, and extending outwards five or six inches. Loosen all the tissues around the neck of the sac, and cut boldly through Poupart's ligament between hæmostatic forceps. If any anomalous or enlarged branches of the deep epigastric or obturator arteries are cut, they can be easily tied.

By sponging back the cord and other soft tissues, a good view is obtained of all the structures around the sac, and it also enables the surgeon to sew the sac high up in the belly cavity.

Open the sac, relieve the constriction, and deal with the contents of the sac according to the exigencies of the case, cut off the sac high up and close it as in an incision in the abdominal wall, with interrupted or continuous catgut suture.

Sew the lower cut end of Poupart's ligament to the fascia lata, with catgut, without restoring its continuity. If the conjoined tendon comes down low enough, it may also be included in the suture.

The portion of Poupart's ligament that forms the outer boundary of the external abdominal ring may be ignored, as the suturing we have described will fill up and obliterate the femoral ring completely. These different steps of the operation in no wise weaken any of the other natural outlets of the abdomen.

Then close the skin with interrupted silkworm gut sutures, put on antiseptic dressing and spica of the groin to retain the dressing and give support to the parts. Keep patient in bed two or three weeks, and let him get up.

A METHOD OF CLOSING ABDOMINAL WOUNDS WITHOUT USING BURIED SUTURES

By GASTON TORRANCE, M. D.
Surgeon to St. Vincent's and Gynecologist to the Hillman Hospital, Birmingham, Alabama

The following method of closing cœliotomy wounds was evolved from a method of closing the "gridiron" appendix wound which I published in the Therapeutic Gazette of November, 1908.

This method deals chiefly with the fascia, which is the principal structure to be considered in the closure of all wounds (abdominal).

The peritoneum is closed by a running mattress suture which brings the fresh edges ot the peritoneum together and turns both cut edges up into the wound leaving no raw surfaces for adhesions in the abdominal cavity.

The fascia is then caught with Kocher hæmostats and dissected back on each side for half an inch or more. In the figure No. 1 the needle threaded with strong silkworm gut (two strands may be used) is passed through both flaps of fascia before piercing the skin. Three sutures will close an ordinary laparotomy wound and two will usually close the wound for an appendix operation through the right rectus.

In Figure No. 2 both edges of the fascia are turned out and the needle is passed back and forth twice making shorter lengths than in the stitch

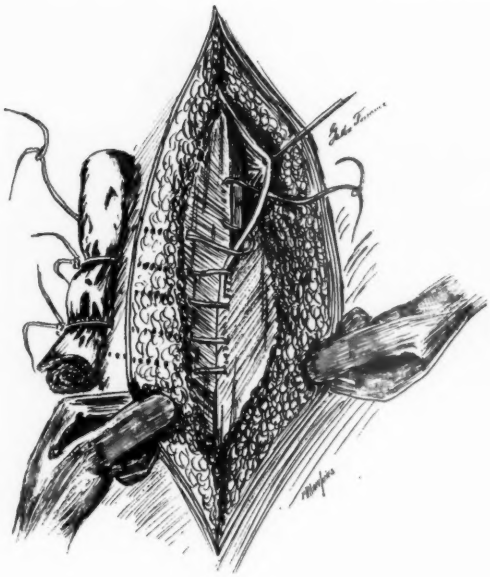

Fig. 1.

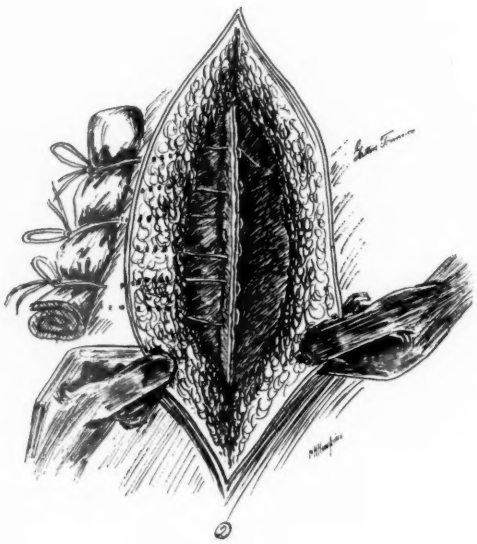

Fig. 2.

shown above. When drawn up tightly the fascia will remain approximated without the sutures being tied. When all sutures have been placed in the fascia the ends of the sutures are again threaded on a cutting needle and made to pierce the skin on one side about an inch from the incision; the ends are tied over a roll of gauze with a bow knot so that they may be untied or loosened in case there is any irritation around the stitches. Some dead space remains beneath the fascia, which is drained by two strands of silkworm gut closely twisted together, this is removed after two or three days. The skin is closed with a subcuticular stitch or Michel skin clips. The skin clips are removed at the end of four days and the silkworm gut sutures are allowed to remain for two weeks; there is usually some irritation around the sutures in the course of a week or ten days, the knot can then be untied and allowed to remain loose until ready to be removed. A distinct ridge can be demonstrated where method No. 2 is used and undoubtedly makes a much stronger wound than where the old haphazard closure by means of through and through sutures is used, and eliminates the danger of infection where heavy catgut is used. I have used this method in about twenty-five cases and have gotten excellent results in each instance.

ABSTRACTS OF CURRENT LITERATURE

DEPARTMENT OF SURGERY

UNDER THE CHARGE OF

JOHN B. MURPHY, M. D.
FREDERIC A. BESLEY, M. D.
WM. C. DANFORTH, M. D.
AIMÉ PAUL HEINECK, M. D.
FRED C. ZAPFFE, M. D.
WM. R. CUBBINS, M. D.
ARTHUR B. EUSTACE, M. D.
FREDERICK G. DYAS, M. D.
M. G. SEELIG, M. D.
GEO. E. BEILBY, M. D.

Jejunal and Gastrojejunal Ulcer following Gastrojejunostomy. HERBERT J. PATERSON. *Proceedings Royal Society of Medicine*, 1909, ii, 238.

In starting it is well to state that no abstract can do this most excellent treatise justice and for those who are specially interested in the subject satisfaction can be had only by reading the original.

Paterson reports two cases and collects sixty-one from the literature. In one of his cases a fistula existed through which the gastric juice and some bile was excreted. He was able to demonstrate in this case that an excess of free hydrochloric acid was present until the diet was properly regulated. He compares the analysis of the stomach contents with that of the fluid escaping from the fistula. He believes that the total acidity tells us little but that the amount of free hydrochloric acid is important in these cases. After careful consideration of the cases and statistics, he believes that jejunal or gastrojejunal ulcer follows gastrojejunostomy in less than two per cent of the cases. As to sex, 78 per cent were men. The average of the interval between the operation and the appearance of symptoms is twenty months. The mortality is much greater where the posterior gastrojejunostomy was performed.

As to symptoms, he divides these cases into two groups. First, those in which the first sign of disturbance is the sudden pain of a perforation with a following fatal peritonitis. Second, those in which pain is the prominent symptom, followed sooner or later by the perforation of the ulcer through the abdominal wall. Hyperacidity of the gastric contents was found in thirteen of eighteen cases in which the analysis was made.

As to the diagnosis, abdominal pain in a person previously healthy who has had a gastrojejunostomy is very suggestive. The ulcer is usually located in the efferent limb of the jejunum, opposite the anastomosis or affects the mucous membrane of both the jejunum and stomach. There may be one or many ulcers. The jejunal ulcers are usually of the ordinary peptic type, but the gastrojejunal are more irregular and less definitely outlined.

As to the etiology, Paterson thinks that nearly all are due to an increase of the free hydrochloric acid in the stomach, but believes that in a few cases in which the ulcer occurred soon after the operation infection was the cause. The type of operation probably has little influence on the probability of the appearance of the ulcer. As to the cause of the hyperacidity, this may be traced usually to dietetic errors.

Of the thirty-one patients who recovered from the operations twenty-five could be followed, of which ten were permanently cured and fifteen suffered relapses of which two died, and in three the final results could not be found out.

Treatment. Some ulcers heal spontaneously. Diet should be watched carefully and bismuth with small doses of hydrocyanic acid and alkalies can be used. The surgical treatment must depend on the condition found.

To prevent the recurrence two things are to be carefully observed: first, technique, and second, after-treatment. Under the first head comes the necessity for a large opening, accurate apposition of the mucous membrane, careful application of the inner suture so as to control bleeding, use of suture material instead of mechanical appliances and avoidance of entero-anastomosis and the "Y-type" operation. The after-treatment should be directed in such a way as to prevent hyperacidity in the gastric juice.

In closing Paterson draws the following conclusions:

1. The risk of jejunal ulcer following gastrojejunostomy is probably under two per cent.

2. At the present time this complication apparently occurs less frequently than formerly.

3. Clinically, there are two groups of cases: (1) those in which perforation into the general peritoneal cavity ensues; (2) those in which general peritonitis is prevented by the formation of adhesions.

4. Pathologically the cases may be classified as follows: (1) ulcers of the jejunum; (2) gastrojejunal ulcers, or ulcers at the site of the anastomosis.

5. Jejunal ulcers in some instances are of infective origin; in these cases ulceration commences within a very short interval after gastrojejunostomy, and usually the ulcers are multiple.

6. In a large proportion of cases the ulcer is single, and is probably the result of the toxic action of hydrochloric acid, which injures the cells of the mucous

membrane so that they are digested by the intestinal juice. Possibly other agents than hydrochloric acid may play a part in injuring the mucous membrane.

7. Gastrojejunal ulcers are a direct consequence of the wound made in effecting the anastomosis, and their persistence is probably the result of hyperacidity of the gastric juice.

8. Closure of a gastrojejunostomy opening is the consequence of cicatrization of a gastrojejunal ulcer. It is more likely to occur when the pylorus is patent, not because of the patency of the pylorus, but because in such cases hyperacidity is usually markedly present.

9. Any procedure or disease which diminishes the amount of bile and pancreatic juice in the jejunum favors the occurrence of jejunal and gastrojejunal ulcer. For this reason operations of the "Y-type" and enteroanastomosis are inadvisable, at any rate in cases in which free hydrochloric acid is present in the gastric contents, as after these procedures the anastomosis and a portion of the jejunum are deprived of the protective influence of the alkaline bile and pancreatic juice.

10. The reason that ulceration has followed the anterior operation more frequently than the posterior operation with a loop, is probably that in former times the anterior operation was more frequently performed.

11. As an instance of ulcer after the posterior no-loop operation has yet been recorded, we must for the present assume that its occurrence after this type of operation is less likely. It is possible, however, that this immunity is partly the result of improvements in technique and in the after-treatment of gastric operations in general.

12. In cases in which perforation into the general peritoneal cavity occurs, immediate laparotomy offers the only chance of saving the patient's life.

13. Inasmuch as there is some evidence that jejunal and gastrojejunal ulcers may heal, an operation should not be performed in the chronic cases until after a thorough trial of medical treatment.

14. Even when surgical intervention is necessary an attempt should first be made to diminish hyperacidity, if this be present.

15. Our aim should be to prevent the occurrence of this complication of gastrojejunostomy. Preventive treatment consists in (1) careful and appropriate surgical technique and (2) prolonged after-treatment.

16. Lastly, every case of recrudescent pain of a constant character after gastrojejunostomy, especially when associated with hyperacidity or hypersecretion should be regarded as a case of potential ulcer, and treated accordingly. C. G. GRULEE.

A Simple and Rational Method of Treating Rectal Prolapse in Children. (Ein einfache, aber rationelle operative Behandlungs methode des Prolapsus recti bei Kindern.) G. EKEHORN. *Arch. f. Klin. Chir.*, b. 89, h. 2.

Ekehorn lays especial stress upon the simplicity and rational basis of his method, the technique of which he describes as follows:

The entire operation consists in passing a transverse suture at a level opposite the lower part of the sacrum, without the aid of an incision of any sort. The prolapsed portion of the rectum is first replaced, steadied in position by means of the left index finger, held within the canal. A long needle, with an eye point, is now made to enter the skin to one side of the median line on a level with the lower part of the sacrum to perforate the soft parts, enter the rectum, and be guided out of the anus, by means of the left index finger. The eye of the needle point is now threaded with a heavy silk suture and the needle is withdrawn from its point of entry. The same maneuver is repeated on the other side, the needle being threaded this time with the other end of the silk suture. Both ends of the suture are then tied firmly over the skin. Oftentimes no dressing or bandage is necessary. The patient need not be confined to bed. The suture is removed after fourteen days.

Ekehorn has used the method only four times; but in every instance the result has been ideal.

M. G. SEELIG.

Prostatic Abscess. (Observations upon the Pathology and Operative Treatment.) SAMUEL ALEXANDER. *Annals of Surgery*, vol. xlix, No. 4.

The author records a series of observations upon the pathology and operative treatment of abscess of the prostate caused by gonorrhœal infection. These cases were treated either by median perineal section and drainage of the abscess into the urethra, or by median perineal prostatectomy.

The abscesses in these cases occurred during that period of life in which gonorrhœal infection of the urethra is most common.

The author states that he is convinced that nearly, if not all ischiorectal abscesses which come under the observation of the genitourinary surgeon are of prostatic origin, and that to effect a radical cure, the source of infection in the prostate must be removed either by drainage of the abscess or by prostatectomy.

As a causative factor in prostatic abscess, stricture of the urethra may play an important role, as it hinders perfect drainage of the urethra.

In a majority of cases retention of urine was complete and the bladder was distended in all of the cases.

As a result of the author's investigations of prostatic suppuration, he offers with confidence the method of operative treatment of prostatic abscess by perineal prostatectomy. He states that as our knowledge of infectious diseases of the prostate becomes more accurate it will become more and more apparent that these suppurative conditions of the prostate cannot be successfully treated by such methods of treatment as are now employed; viz., overdilatation of the urethra and massage. A. B. EUSTACE.

Tuberculosis of the Thyroid Gland. (La tuberculose du corps thyroïde.) LENORMANT. *Progrès, méd.* No. 37, *Archives Générales de Chirurgie*, March, 1909.

In the thyroid gland two types of lesions may be found. The lesions of toxic sclerosis, atrophic or hypertrophic in type are the more frequent. The lesions of specific tuberculosis are rare, but they con-

stitute true thyroid tuberculosis. Thyroid tuberculosis may evolute into tubercle formation; may evolute into the formation of caseous foci. In the latter form there is an irregular bumpy tumor formation — a tuberculous goiter. In other cases we find a cold abscess gland located either in the isthmus or in one of the lateral lobes and simulating by its painlessness or by its fluctuation a thyroid cyst.

Lenormant observed a cold abscess of the thyroid gland in an individual 40 years of age. He curetted and drained the pouch. The results were not satisfactory. Simple incision with curettage, enucleation of the tuberculous membrane, enucleation of caseous nodules are, in the opinion of Lenormant, insufficient operations. He believes that in cases of this nature partial thyroidectomy is indicated.

AIMÉ PAUL HEINECK.

Technique of Implantation of Ureters in the Intestine. (Zur Technik der Ureterenimplantation in den Darm.) Dr. W. W. SSIZEMSKY, in Moskau. *Zentralblatt für Chirurgie*, May 15, 1909.

Ssizemsky discusses this question as follows:

The experimental animal researches of implanting the ureters into the intestine in dogs has given unfavorable results. Dr. Mirotworzew in the last surgical congress at Moskow reported the results of his experiments upon dogs and said that over one-half the animals had died. Dr. Mirotworzew's results substantiate the findings of other authors. The clinical observations of the latter at the same surgical congress substantiated the animal experiments. Of twenty-eight cases of bilateral ureteral implantation in the intestine nine cases died in the practice of Professor Tichow. In the clinic of the late Professor Diakonow two women were operated and both died several days after the operation. Nevertheless, this operation in the future doubtless will be performed, because the indications are so urgent. The need for this operation is greatly heightened in Russia through the extraordinary number of unfortunate women amongst the peasant folk who, after severe labor without medical attention, suffer extensive necrosis of the vesico-vaginal wall, leaving colossal defects which are beyond the aid of plastic surgery.

The operated patients as a rule, develop either an ascending pyelonephritis, or a peritonitis from the escape of urine. The two cases of Dr. Diakonow died from the latter. The perfection of the technique of this operation must have in mind in the future on the one side the avoidance of an ascending pyelonephritis, and upon the other the avoidance of a post-operative peritonitis from extravasated urine. The author performed the following operation of ureteral implantation upon a number of cadavers for the purpose of making a strong union of the ureter with the intestine and avoiding retrograde post-operative extravasation of urine in the peritoneal cavity. He incises the ureter as it crosses the posterior part of the pelvis and strips back peritoneal flaps with the surrounding cellular tissue for about 6 to 7 cm., then makes a corresponding incision in the intestine upon the point of a sound introduced through the rectum into the intestine. The end of the ureter is then drawn through the small incision and pulled into the intestine for about 1 to 1½ cm. As the incision is a very small one the edges lie close to the introduced ureter which is now secured by two lateral sutures in the incision.

The serosa of the ureter is sutured to the muscularis of the intestinal wall. The muscular layer of the ureter is sutured to the surrounding cellular tissue, then the serous border of the ureter along its course and the serosa of the intestine are sutured together. After such a fixation of the ureter he decapsulates the kidney, incises the ureter at its origin, and forces water through it under considerable pressure. The water after it has reached a certain pressure in the intestine comes out through a tube introduced in the rectum without being forced into the peritoneal cavity.

One must bear in mind two conditions in this method: In the (1) loosening of the peritoneal flaps, the subperitoneal tissue must be also loosened in order that the ureter may be completely surrounded by it. (2) The operation is not always easily performed. With well developed and loose cellular tissue, the ureter is quite movable.

FREDERICK G. DYAS.

The Opening of the Abdominal Scar after Laparotomy for Tubercular Peritonitis. (Ueber das Auf platzen der Bauchnarbe nach Laparotomie wegen tuberkulöser Peritonitis.) SARRA RABINOVA. *Prager Medizinische Wochenschrift*, No. 22, 1909.

After reviewing the literature and reporting a case, Rabinova suggests that to prevent such an accident a strip of peritoneum 1 to 1.5 cm. wide be removed from each side of the abdominal wound, thus preventing the peritoneum from being drawn into the wound when the latter is sutured.

C. G. GRULEE.

A Contribution to Thyroid Surgery. (Contribution à la chirurgie thyroïdienne.) DELORE ET CHARLIER. *Archives Générales de Chirurgie*, March, 1909.

From the surgical standpoint two forms of goiter can be distinguished, the enucleable and non-enucleable form or diffuse form. The enucleable goiters form the majority of cases. The authors insist upon the importance of surgical intervention in intracystic hæmorrhages (thyroidian hæmatocele), in secondary exophthalmic goiter, indiving goiter, in thyroidean psychoses.

In cases of goiter the authors have practiced enucleation, either massive or intraglandular, making use of Köcher's curvilinear incision. If during the course of the operation asphyxia develops, the operation is continued with the patient in the sitting posture. Only in exceptional cases will tracheotomy be indicated. The inclusion of the recurrent laryngeal nerve in a ligature provokes a glottic spasm.

Inflammations of the thyroid of goiters calls for large incision and drainage. When the wall of the suppurating cyst eliminates itself, it is well to ablate the pouch by performing a partial thyroidectomy.

In one case of suppurating goiter the authors removed the organ, and in two cases they performed an early strumectomy during a febrile period.

AIMÉ PAUL HEINECK.

ABSTRACTS OF CURRENT LITERATURE

DEPARTMENT OF OBSTETRICS

UNDER THE CHARGE OF

C. S. Bacon, M. D. — Ralph Waldo Lobenstine, M. D.
Heliodor Schiller, M. D. — C. G. Grulee, M. D.

Extraperitoneal Cæsarean Section. (Uber den extraperitonealen Kaiserschnitt.) A. Döderlein. *Zentralblatt für Gynécologie*, No. 4, 1909.

Döderlein in this article first makes the point that despite all improvements in technique which have been adopted in performing Cæsarean section, nearly all operators, even after many fortunate results and long series of recoveries, have met with unexpected fatalities. Even the transperitoneal operation, with Sanger's method of stitching the uterine wound and the various locations of the uterine incision, in the anterior or posterior wall or in the fundus, has not yielded satisfactory results in all cases. Many reasons for this may exist, but the presence of sources of infection in the field of operation is becoming more and more dreaded, together with the tendency of the uterine incision to become adherent, especially with coils of the intestines. This probably explains why Frank's method of making the operation extraperitoneal was so widely accepted, especially after Sellheim's technical improvements. Yet with all of the modifications, the peritoneal cavity is opened, even if for a short time and the closure of the cavity is obtained by the temporary or permanent suture of the parietal to the uterine peritoneal folds. Therefore, these methods are not, strictly speaking, extraperitoneal, but transperitoneal, and hence the abdominal cavity is not absolutely protected from contamination.

Döderlein therefore now offers a true extraperitoneal route of access to the lateral extraperitoneal parts of the lower uterine segment. This is done, with the aid of Pfannenstiel's transverse incision, without opening the peritoneum. By this method it is not necessary to detach the bladder from the peritoneum and genital canal nor, indeed, is it detached at all. The fold of the peritoneum attached to the lateral pelvic brim is easily found and pushed upwards, so that the cervix can be split longitudinally down to the external os if desired. The child is extracted, the placenta, manually or by expression, as required, and the uterus is closed by a continuous catgut suture. In infected or suspicious cases the paracervical tissues are drained by way of the vagina. The abdominal wound is closed without drainage. The author reports briefly three cases illustrating this method.

Carey Culbertson.

The Treatment of Pernicious Vomiting of Pregnancy. V. Wallich. *Annales de Gynécologie et d'obstétrique*, April, 1909.

Wallich divides the treatment of the pernicious vomiting of pregnancy into three groups, viz.: the dietetic, the therapeutic, and the obstetric.

1. *The diet.* All food should be withdrawn, excepting *milk*. This can be given in full strength or diluted. It should be administered in fractional doses, not more than one teaspoonful at a time. If this is *well-born*, the quantity is gradually increased; if however even small doses of the milk are not retained, the patient should be given nothing but *water*. If water is well-born, there should be a gradual return to the fractional doses of *milk*. On the other hand if water even is not tolerated, everything must be stopped by mouth, and saline irrigations with nutrient enemata, instituted. After a few days, the fractional doses of water or milk are again tried.

When milk is retained, an increase in the diet can be started, but a *vegetarian diet* must be adopted. Great stress is laid upon cereals, vegetable soups, etc.

2. *The therapeutic treatment* proper must be a simple one. Wallich shows a marked preference to *chloral* in the saline enemata, and to inhalations of oxygen. These inhalations of oxygen, if frequently repeated, are of real merit.

3. *Obstetric treatment.* The chief question that presents itself is the one of the *interruption of the pregnancy*. The uterus should be emptied as soon as the pulse rises above 100 (Pinard).

This intervention should be practiced, *despite a rise in the total output of urine* (artificially obtained), if *vomiting* is continuous and if the nervous phenomena persist. The temperature curve is not as important as the pulse curve.

It is unwise to temporize too long.

Ralph Waldo Lobenstine.

Congenital Goiter. M. Ch. Gonnet. *Revue Meusuelle de Gynécologie, d'obstétrique et de Pédiatrie.*

Congenital goiter is of much more frequent occurrence than is generally supposed.

Demme, in 642 cases of goiter, found 37 in the newborn and 59 in infants from 2 to 12 months of life.

Diethlin, in 2,292 cases of goiter, observed the condition in 25 cases during the first year.

In 1906, Richard found 43 cases of *really congenital goiters;* in 1909 Thevenot reported 130 cases; while at the last Reunion Obstetricale de Lyon, 17 cases were presented.

There are two essential types of congenital goiter: (*a*) The vascular goiter; (*b*) the cellular goiter. The vascular goiters are largely dependent upon mechanical influences, which cause either *direct* trauma to the thyroid gland or *indirect* trauma from excessive disturbance in the circulation of the gland. The condition is found most often in "face presentations" and in "persistent occiputposterior deliveries." Direct injury may occur also from faulty instrumentation during labor.

The *parenchymatous goiter* is, more strictly speaking, the *only* truly congenital type. The etiology of these cases is uncertain. Syphilis does not seem to play an important part in its causation.

Demme, in 53 cases of congenital goiter, found that in 37 of the 53, one or both parents suffered from goiter. In 23 cases the mother alone was affected.

Richard, in 43 cases of congenital goiter, found the condition of goiter in the mother 22 times and once in both father and mother.

In the 17 cases reported at Lyons, a goiter was found both in mother and child in eight instances. Three generations have been known to have had the disease.

The thyroid hypertrophy is found in three different locations: (*a*) the superficial portions of the lateral lobes; (*b*) the deep portions which may compress the trachea posteriorly; (*c*) in some cases the compression is largely lateral and posterior but involving also the isthmus, giving but little external manifestation of the pressure of a goiter; such cases are the most dangerous and are called "circular goiter."

The diminution in the caliber of the trachea from compression may be very marked. The œsophagus may be involved also.

Symptoms. There may be no clinical signs of the presence of a goiter, until long after the birth. In some cases the newborn infant presents marked signs of asthma. Perhaps the greatest number of cases present a *cyanosed condition* and *dyspnœa*. The cry is rasping and shrill. The hypertrophy is rarely larger than a plum and may be so hidden in the neck that it is difficult to definitely ascertain its exact size. At times the swallowing is difficult and the child may refuse to nurse.

Prognosis. The prognosis is very uncertain — more favorable in the vascular type. The greater the size of the growth the more liability to compression.

Death is often very sudden after the ligation of the cord. Frequently the respiratory symptoms diminish steadily. In the list of 17 cases reported at Lyons, the mortality was 6 per cent.

Treatment. In the cases of maternal goiter, it might be wiser to give the mother iodothyrine preparations.

In the case of the infant, cold cloths to the throat may relieve the congestion; intubation may be necessary.

At times early removal, when possible, will offer the best results.

Tracheotomy is universally condemned, as the infants usually die of bronchopneumonia or hæmorrhage.

If the isthmus is involved the mere section thereof will relieve the symptoms.

RALPH WALDO LOBENSTINE.

The Position of the Bladder during Labor. DR. ED. MARTIN. *Arch. für Geburtshülfe u. Gynækologie.*

The position of the bladder, at the onset or during labor, when well distended with urine, is easily to be recognized; but it is considerably more difficult to ascertain the exact position of the empty or partially filled organ. Fehling and Holliday Croom were the first apparently to scientifically study this question. They both found that the cervix at the beginning of labor was more apt to lie somewhat to the left of the median line and the well-filled bladder slightly to the right. The explanation for this was thought to depend upon the greater number of L O A positions of the head.

Gauss was the first to take X-ray pictures of the bladder after filling the latter with a solution of bismuth. He found that the bladder remained until the end of pregnancy in the same position and of the same shape as in the non-pregnant state.

Martin has attempted by means of careful studies with the X-rays, to ascertain positively, the action of the bladder during labor and the cause of its linear deviation.

For this purpose Martin made use of a soft Müller's tube. The exposures varied from five to eighteen minutes, depending upon the position of the fœtal head and the musculature and fatty tissue of the patient. Martin presents drawings taken from the X-ray plates, showing the relative positions of the bladder and the fœtal head, to the symphysis pubis. He deducts from his experiments the following facts:

During labor, the bladder is displaced to one side and usually the right. In the twenty-two women that he studied, the bladder was displaced to the right in twenty-one and to the left only in one case. This displacement to the right is independent of the position of the fœtus, but is explained largely by the axial rotation of the uterus, which, as we know, usually exists, and in the vast majority of the cases, this axial rotation is to the right. The amount of such displacement of course varies very much in individual cases, depending — aside from the rotation of the uterus — upon the size of the presenting part, the amount of the liquor amnii, and the thickness of the connective tissue supports of the bladder. Although usually the trigone remains practically in the median line, still at times in deformed pelves and transverse presentations, even the trigone itself and the upper portion of the urethra may be displaced slightly to the right.

That these conclusions are accurate may be further

substantiated by the use of the cystoscope and by the fact that there comes a time when a male metallic catheter no longer can be introduced into the bladder, exactly in the median line, but the tip of the instrument, as it hugs the under surface of the symphysis, must be turned a little to one side, before drawing urine, and this usually to the right.

RALPH WALDO LOBENSTINE.

Modern Treatment of Placenta Prævia. (Was leistet die moderne Therapie bei der Placenta prævia?) *W. Hannes. Zentralblatt für Gynecologie*, No. 3, 1909.

Hannes publishes in a short article the results of his experience in the Breslau Klinik and Poliklinik with the treatment of placenta prævia. He strongly opposes the teaching of Sellheim and Kronig, advocating hystereurysis and illustrating the superiority of this method in the presentation of a table of 246 cases altogether. Only 16 of the mothers died, 6.6 per cent; but of the 143 treated by hystereurysis only 8 died, 5.5 per cent. This is the lowest mortality hitherto recorded, Hammerschlag's, by the Braxton Hicks' method, being 6.3 per cent. Moreover, the septic mortality was only 1.8 per cent, though Hofmeier estimates it to be, even now, 2.2 per cent in cases of placenta prævia. Eliminating the cases in which, when the treatment was begun, the children were not viable, or were dead, or seriously injured, the results for the rest were as follows:

Treatment	Cases	Born Alive
Hystereurysis	86	60
Rupture of membrane	17	17
Forceps	4	2
Version and extraction	25	20
Colpeurysis	15	3
	147	102

In number ten of this same Zentralblatt, V. Zimmermann, of Duisberg, offers a short contribution on the same subject of placenta prævia and its treatment. He agrees with Hannes except that he does not rupture the membranes before introducing the metreurynter. Several years ago he found that the treatment of placenta prævia by metreurysis gave a mortality of 23.7 per cent for the children, and only 3.3 per cent for the mothers. In the last six years he has treated 28 cases, all of which happened to be in the 36th to 40th week of pregnancy, with living children and unruptured membranes. All of the children were born alive and not one of the mothers had any kind of trouble.

CAREY CULBERTSON.

Spontaneous Rupture of the Bladder in a Pregnant Woman of Three Months. PROF. ALBERT MARTIN. *Annales d'Obstetrique et de Gynécologie.*

This case is given in full owing to the rarity of the accident. On the 14th of January, 1909, Martin was called at an early hour in the morning in consultation with his assistant, Dr. Vallée. This patient had suddenly been taken with violent abdominal pain and after an hour of this pain had called her physician. Dr. Vallée made the diagnosis of a retroverted pregnant uterus; but in the presence of great abdominal tenderness, pinched facies, rapid and small pulse, he was not satisfied with this diagnosis alone and called his chief, Prof. Martin. The patient was twenty-five years of age, a primigravida, and up to within a few days, the pregnancy had been normal. During the past few days had had trouble in urination, passing the urine frequently and in small quantities; had gone to bed feeling almost normal, and it was not until about one o'clock of the night in question, that she suddenly had the pain after urinating.

Martin and Vallée decided at once that a laparotomy was necessary and transported the patient to the hospital, in an automobile. The condition was growing worse — pulse 130, constant vomiting, etc. Catheterization brought away about eight ounces of bloody urine. At 4 A. M. the laparotomy was performed. A median incision 10–12 cm. was used. On opening the peritoneum, urine began to escape. There were about 2–2½ litres of urine in the peritoneal cavity. It was rapidly made out that the bladder presented a laceration 4–5 cm. long. The peritoneum was dried quickly, the patient put up in the Trendelenburg position and the bladder drawn up into view. Martin sutured the wound, in two layers, with catgut. The first layer was passed through the entire bladder wall while the second suture merely included peritoneum. He then replaced the uterus, but this required considerable effort and could only be kept in place by thorough vaginal tamponade.

Martin does not believe in suspension operations on the gravid uterus. The abdominal wound was closed, leaving room, however, at the lower angle for a gauze drain. A permanent catheter was introduced. The first few days after the operation were uncertain ones, but by the fifth day the drain was removed and the wound healed rapidly. There was some temperature for a month and some pyuria from a cystitis and pyelitis. Gradually the patient recovered and left the hospital at the end of the sixth week. She progressed satisfactorily and at the time of this presentation (May, 1909) she is eight months' pregnant.

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